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SIXTY-NINTH YEAR

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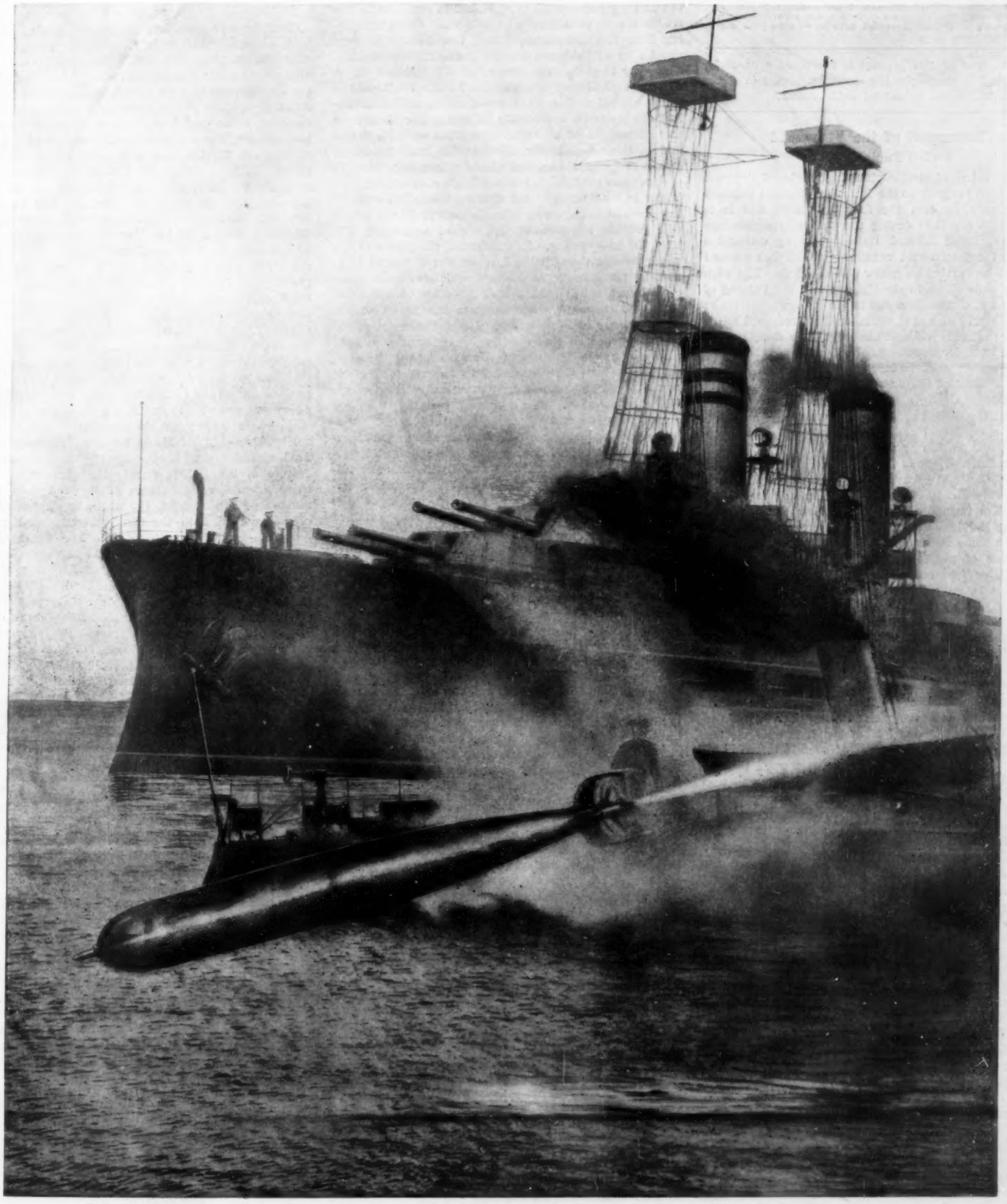

The air exhaust from the torpedo is clearly visible, passing astern from the after end of the torpedo.—[See page 8.]

A WHITEHEAD TORPEDO JUST AFTER ITS DISCHARGE FROM AN ABOVE-WATER TUBE

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Retrospect of the Year 1912

Civil Engineering.

IN a review of civil engineering works of the past year the progress of the Isthmian Canal at Panama naturally receives the first attention; and it is sufficient to say that during the year this stupendous task has moved toward its approaching conclusion with that uninterrupted regularity which has marked the work as carried on under Col. Goethals. Not even the enormous slides in the Culebra cut, the bulging of the slopes at Gatun Dam due to the hydraulic action at the semi-liquid core of the dam, or the threatened settlement of the guide walls at the locks have dismayed the working force for a moment. Each crisis has been met and mastered; and, to-day, everything promises fair for the sending of the first ship through the canal (in an experimental way) in the autumn of the present year, and the official opening on January 1st, 1915, not only of a completed canal, but of a canal whose mechanical and human operating forces are in thorough working order. Next to the Panama Canal in the magnitude of the total excavation is the Ambrose Channel, 40 feet deep and 2,000 feet wide, extending for nearly seven miles from deep water into New York Harbor. Not many people understand that this great work, which has been done so unostentatiously, has involved the excavation of nearly seventy million cubic yards of material, or just one third of the amount that will have been taken out when the Panama Canal is completed. The canal is 98 per cent dug and the early months of the present year will see the task completed. The Ambrose Channel will form another monument to the efficiency of that able professional body, the Engineer Corps of the United States Army. The year has seen steady work done upon yet another great engineering task, that of damming the Mississippi River at Keokuk, Iowa, where a dam about a mile in length is being constructed, and a hydraulic electric plant, with a first installation of some 250,000 horsepower will serve to transform the energy of the impounded water into light and power. The power house will be extended from time to time as the commercial demand increases. Great progress has been made on the New York State Barge Canal, which will make it possible for thousand-ton barges to navigate between the Great Lakes and New York city. Practically the whole of this great work of reconstruction is under way; much of it is completed; and the opening of the canal is promised by the year 1915. Another important waterway, the Welland Canal, a Canadian competitor of the State Barge Canal, is to be greatly enlarged at an estimated cost of $45,000,000. The improvement will extend from Port Colburne to a short distance north of Thorold. The depth will be increased from 14 to 25 feet and 30 feet in the locks, and it will be widened from 150 to 200 feet. The locks will be reduced from 22 to 7; and eight hours' time will be saved between Port Colburne and Fort Dalhousie. Such good work has been done on the Cape Cod Canal, that its completion and opening are promised during the next winter, or, at the latest, in the early spring of 1914. This waterway will provide a 25-foot depth from Barnstable Bay to the 30-foot depth in Buzzard's Bay, a distance of 12½ miles. The work of providing an additional daily water supply of 500,000,000 gallons for New York, known as the Catskill Water Supply, has made great advancement during the past year. The Ashokan Dam is practically completed, the huge siphon, passing 1,100 feet below the Hudson River, is concreted, much of the aqueduct, which is from 12 to 17 feet in diameter, is also completed, the shafts for the deep-water tunnel below New York are driven and in some cases the headings of the tunnel have been broken through, and it is promised that this year water from the Catskills will be turned into the Croton Reservoir, thereby removing any immediate danger of a water famine in this city. Mention should be made of the work that has been done in completing the Los Angeles Aqueduct, through which water will be supplied to that city from a point in the Sierra Mountains, 240 miles distant. The work will include forty-seven miles of tunnel and nine and one third miles of inverted steel siphons, some of which are ten feet in diameter.

Electrical Engineering.

Although no single achievement stands out very prominently in the field of electrical engineering for the year 1912, nevertheless there has been general activity and a steady, healthy growth in all lines of electrical work. This has been marked by a determined effort to promote the electric vehicle for pleasure and for commercial service, and to promote the introduction of electricity on the farm. One enterprising New England company has introduced the very novel idea of having a traveling electrical exhibition. The show is given in a circus tent which is set up in various agricultural communities in the neighborhood of the central station plant, and farmers and suburbanites are given an opportunity of seeing for themselves the advantages of electrical apparatus on their farms and in their own homes. One of the most important electrical undertakings has already been mentioned in the previous paragraph, because in its construction it is of particular interest to the civil engineer. We refer to the Keokuk Dam across the Mississippi River, which will provide hydro-electric power of something like 1,000,000 horse-power. In California, the power of the water flowing through the Los Angeles Aqueduct is to be fully utilized. Seven hydro-electric plants are being constructed, and it is estimated that they will generate 138,000 horse-power. According to the report of the Commissioner of Corporations, 6,000,000 horse-power is now developed in this country by water, and several million more could possibly be developed from the same source. Abroad there have been some very important water power developments, particularly in Norway. There preparations are under way to develop 500,000 horse-power in addition to the existing 430,000 horse-power. This doubling of the amount of current generated is due to the demand of electro-technical industries. There has been some activity in the electrification of steam railroads. Locally, the most important item for the year is the work of the New Haven Railroad in extending its electrified zone from Stamford to New Haven. The new equipment will be practically identical with that on the existing electric road, indicating that the company is evidently satisfied with the efficiency of its present electrical installation. The most interesting railroad work abroad has been the completion of a Jungfrau railroad, which provides access to the summit of that lofty peak. In Mexico an electric railroad has been proposed to run to the summit of Mt. Popocatapetl, not for the purpose of carrying passengers, but to permit of transporting sulphur from the mine in the crater. Ten enormous electric locomotives are being built for the Swiss railways. They will weigh 108 tons each and will be the most powerful single unit electric locomotives so far, being capable of developing 2,500 horse-power at a speed of fifty miles per hour. Each can exert a draw-bar pull of 40,000 pounds. The use of the storage battery for traction purposes is increasing. Recently a storage battery train was built and shipped to Cuba for use on the Havana Railroad. Storage battery cars are meeting with continued favor in New York city, and the storage battery locomotive is being used very extensively in the aqueduct tunnels and the new subway work. The most prominent event in the field of wireless telegraphy has been the completion of the Naval Station at Arlington with its 600 foot antennæ. In Germany, at Nauen, a tower 970 feet high is being erected, which is expected to have a radius of 6,000 miles. In France a system of wireless telegraphy without sparks has been developed, giving wave-lengths about ten times greater than has heretofore been possible with a given antenna of the sheet type. Following the loss of the "Titanic" in April, radical measures were taken to provide for constant attendance upon the wireless telegraph apparatus on board ship. In addition to this, there have been important regulations to control the amateur wireless telegraph operator. No amateur is now allowed to operate a transmitting instrument of power sufficient to reach beyond the borders of his State, without obtaining a license from the Government. Transatlantic wireless telegraphy is now conducted on a reliable commercial basis. Before dropping the subject of wireless telegraphy we must refer to experiments with the wireless control of torpedoes in which some material progress has been made during the year. Some progress has been made in long distance telephony. England is now able to talk directly with Switzerland. This long distance communication is of course made possible by the use of Pupin coils in the lines. In this country the telephone is being increasingly used for train dispatching. Experiments with the telegraphic transmission of photographs are still being carried on abroad, although little, if anything, has been done in this country as yet. The electric steel furnace is steadily making its way into the steel plant. We have recently learned that an all-electric steel melting plant is being built in Sheffield, England, the home of the steel industry. At the Panama Canal electricity is to be used very extensively for light and power purposes. The towing engine at the locks will be driven by electricity, and the lock gates will also be operated by electric motors. To furnish the power necessary for this purpose, a hydro-electric plant is being built which will obtain its power from Gatun Lake. Altogether there will be about 7,000 lamps at the locks and 1,000 individual motors.

Naval and Military.

Conditions in the Navy during the past year have been eminently satisfactory, with the one important exception that Congress saw fit to cut down the annual appropriation for battleships just one half, authorizing the construction of only one such vessel this year. A striking evidence of the efficiency and preparedness of the Navy was afforded by the great review at New York last autumn, when, at short notice, a fleet of 123 ships, aggregating 720,480 tons was gathered in the North River. In 1912 there were 166 ships in active service or ready for service as against twenty on the repair list—certainly an excellent showing. The quality of our ships is excellent, but in number they are too few. When all ships built, building or authorized are taken into account, we find ourselves dropping quickly behind the other leading powers; for, in dreadnoughts, it is shown that England has 36 ships, Germany, 23, and the United States, 13 only. On the same basis, the relative order of tonnage is Great Britain, 2,478,152 tons; Germany, 1,124,267 tons; and the United States, 898,435 tons. Congress should authorize at least three dreadnoughts this year to repair last year's deficiency. Oil fuel has proved such a success that it will probably be used exclusively in future warships. The oil-burning destroyers are able to run at all speeds with perfectly clean smokestacks; and the new battleships, "Nevada" and "Oklahoma," of 27,500 tons displacement, will be fired exclusively with oil. Apart from the important feature of invisibility, due to the absence of smoke, there are other advantages of the reduction in the number of smokestacks, the abolition of bunkers, the oil being carried in the double bottom, and a great reduction in the operating staff. The mechanical reduction gear on the "Neptune" has proved to be satisfactory—eminently so, and new turbines, more suitable to the conditions, are being built, which are expected, in connection with the gear, to show the many advantages of economy and convenience of operation, which have been predicted, both in the motive power and the control of the ship. The "Jupiter," which is to have electric reduction gear, will probably undergo her trials in the near future, and it is confidently believed that the theoretical advantages of this type will be fully demonstrated. During the year foreign powers have continued to build battleship-cruisers which combine a battery of the heaviest guns with fair armored protectection and extraordinary speed. The "Moltke" and "Goeben" of the German navy are credited with trial speeds of 29 to 30 knots, and the "British Lion," carrying eight 13.5 guns, has made an average of 33 knots in six trials on the measured mile. We should build at least one experimental ship of this type. The destroyer continues to prove its efficiency and general serviceableness, and the leading powers are agreed that at least four of these ships should be built to each battleship. The submarine increases in size, speed and offensive power. It is proving so successful that some authorities consider that it may dominate the warfare of the future. The coast fortifications of the United States are practically completed, and work has been pushed actively on the fortifications of the Philippines and the Panama Canal. The new army 14-inch gun gave every satisfaction in its earlier trials at the proving grounds. One wirewound and two hooped guns of this type have passed successfully through their trials. The fourth gun, when fired with its maximum charge, exploded, the breech and outer hoop being torn apart. This matter is now under investigation, and our ordnance officers believe that the defect is one that can be fully remedied in future guns. The disappearing mount is favored for coast fortifications; but some turret mountings are being built for the defenses at Manila.

The Merchant Marine.

In any review of the past year in matters affecting the Merchant Marine, the tragic loss of the "Titanic" naturally receives first consideration. Next to the pitiful loss of some 1,500 people, the most disquieting feature

of the tragedy was the fact that the ship was the latest and largest of the great ocean liners, and that she came from one of the finest shipbuilding yards in the world. It is now well understood that her loss was due to the fact that she was insufficiently sub-divided. The test was of course a supreme one; nevertheless she should have been so well protected as to stay afloat, even under that terrible ordeal. The disaster drew attention to the fact that shipbuilders have not lived up to the high standards of under-water protection set by Brunell, when he built the "Great Eastern" over half a century ago. That the White Star Company, at least, learned this lesson, is shown by the fact that her sister ship, the "Olympic," is now at the Belfast yards, where she is being provided with a double skin throughout the greater part of her length, and her subdivision is being greatly amplified. Similar changes are being made in the "Britannic," which is now under construction. Both the Senate inquiry in this country and that under Lord Mersey in Great Britain emphasized the necessity, not merely of providing life-boats for everyone on board, but of so thoroughly subdividing a ship that a repetition of the "Titanic" disaster will be rendered impossible.

Great as are the ocean steamships of the present day, their dimensions still continue to increase. Next spring, the "Imperator," 919 feet in length, will be dispatched by the Hamburg-American Line to this port, and about the same time the Cunard Company will send over on her maiden voyage, a ship of approximately the same size, something over 900 feet in length, which will be an enlarged "Mauretania" with somewhat less speed. The past year has seen an active revival of the burning question of providing longer piers to accommodate these ships at the port of New York; and a bill has been introduced into the House favoring the straightening of the pierhead lines from the Battery to Pier 30, which will provide accommodations for twenty piers from 950 to 1,040 feet in length. The oil engine continues its invasion of the field of marine transportation, which for so long has been held exclusively by the steam engine. The successes of the past year have been truly phenomenal. Two large freight steamers, the "Selandia" and the "Christian X" have proved successful even beyond expectations. These are sister ships. The "Christian X" made her maiden voyage across the Atlantic last September. She is 370 feet long, has a displacement of 10,200 tons, and is driven by twin Diesel engines of a combined maximum indicated horse-power of 2,500. She steamed, on her maiden voyage from Hamburg to Havana, 4,627 miles at a speed of 11.1 knots, with a consumption of only 0.34 pounds of oil per hour. Engines of even larger size are under construction, and it now seems certain that within the next few years oil motors will be applied to ocean ships of the very largest size.

Steam Railroads.

On steam railroads, at least in the United States, there is a growth in the size and weight of the individual unit, corresponding to the increase which we have noted under the head of Merchant Marine among the ocean steamships. Both for freight and passenger service the modern engines have attained proportions undreamed of only a few years ago. The Pennsylvania Railroad Company has recently completed a passenger engine for its heavy, fast, mountain service, with a total boiler heating surface of no less than 6,000 square feet. It is not so many years ago that 3,000 square feet of surface was considered extraordinary. A gratifying fact is the steady growth in the number and popularity of all-steel passenger cars. The Pennsylvania Railroad set a good example by building no more passenger cars of wood, and before long the whole of its service will be of steel construction. Other railroads are following suit. The steel car is one of the greatest protections to human lives and limbs in the event of derailment or collision. But with this increase in the weight of rolling stock comes the realization of the fact that the track is not equal to its work. Not only must rails be made heavier, but—and this is far more important—they must be made of a much higher grade of steel. The rail breakages of the past few months have increased in number and have proved frightfully disastrous. The remedy is to be found chiefly in a more careful casting of the ingots, taking all the time that is necessary to secure sound metal, and in the introduction of one or other of the successful methods of ingot casting, notably that of Hadfield, which have been developed abroad. This, with more careful work in the rolling mills, will make it possible to turn out a steel rail that will not be a cause of continual, heart-breaking anxiety to those who build and operate our railroads. Given perfectly sound and reliable rails, creosoted ties, tieplates of ample surface on every tie, and the replacement of the inefficient spike by the screw spike, and we shall have tracks over which our trains may be run at the highest speed with perfect safety. These changes, coupled with that "general stiffening of discipline," of which the railroad managements have so much to say in these days, will go far to reduce our present appalling annual totals of killed and injured.

Astronomy.

The most spectacular event of the year was the discovery on March 13th of a nova or new star by Enebo, an assiduous Norwegian observer of variable stars. When first seen it was a little above the fourth magnitude, but by March 16th it had sunk almost to the fifth. The spectrum of the new star presented the typical appearance of many novæ—broad, bright and dark bands, widely displaced, with this exception: Prof. Kuestner of Bonn found dark lines of uranium and radium emanation in the spectrum. The import ance of that discovery can hardly be over-estimated, since it may help to shed some light on the moot question of the origin of novæ in general. One of the most important astronomical events was the recapture—if we may so speak—of a very remarkable asteroid on October 3rd, 1911, by Prof. Palisa of Vienna. All the asteroids move eastward, around the sun; but the eastward motion of all previously known planets (except Eros at perihelion) is slower than that of the earth, so that we leave them behind and they seem to move toward the west. The news of the discovery was spread abroad by telegraph, and on the following night another observation was secured by Palisa, and two by Techule at Copenhagen. Bad weather set in; the moon came along and made the sky too bright to see faint stars; and, after she had gone, the new planet was lost and could not be recovered. Mr. Haynes of the University of California, using certain very powerful methods of calculation, developed by Prof. Leuschner of that university, succeeded in getting an approximate orbit, which was published last April. Thanks to Haynes, the planet has been identified on a plate taken at Heidelberg in the middle of September and one exposed at Johannesburg on October 18th.

Dr. Slipher, the able assistant of Dr. Percival Lowell at Flagstaff, for the first time obtained evidence concerning the rotation of the planet Uranus. Spectroscopic observations show this to be a little over fifteen hours, the direction of motion being retrograde. A comet visible to the naked eye was discovered by Gale of Sydney, Australia, on the morning of September 9th. Its orbit proved to be nearly, if not quite, parabolic in form, and was remarkable chiefly for the fact that its plane was almost at right angles to that of the ecliptic. Its closest approach to the sun occurred on October 5th at a distance of 67,000,000 miles. A second comet was discovered by Schaumasse at Nice, on October 18th. As soon as its orbit was roughly computed, it was seen that it was moving in a path very similar to that of a well-known periodic comet—Tuttle's—which last appeared in 1899. But, according to the orbit then computed, this comet is not due to return until January, 1914. Fayet, a colleague of the discoverer of the comet on its present return, made a preliminary calculation of the motion of Tuttle's comet since 1899 and found that toward the end of 1900 it passed within 70,000,000 miles of Jupiter, whose attraction considerably modified its period, and accelerated its return by three months. The comet is of interest on account of its period—thirteen and a half years—intermediate between the numerous groups with periods varying from five to seven years and the longer periods, like that of Halley's comet, and also because of the high inclination of its orbit to the plane—fifty-four and a half degrees. A third comet was discovered by Borrelly at Marseilles on November 2nd. An eclipse of the sun occurred on April 17th. The distance of the sun and moon happened to be in just such a ratio that the two bodies, as viewed from certain parts of the earth's surface appeared of exactly the same size.

There was a total eclipse of the sun on October 10th, visible in a small part of the southeastern United States as a partial eclipse just after sunrise. The trail of total obscuration began in the Pacific off the coast of Nicaragua, crossed South America from one point in Ecuador, a little north of Quito, to one in Brazil a little south and west of Rio de Janiero, after which the whole course was lost in the South Atlantic. The greatest observable duration of totality was about one minute and sixty seconds on the Brazilian Coast.

Miscellaneous Science.

While there has been every sign of activity and successful advance in all branches of pure and applied science during the past year, we have no one particularly striking discovery to record. The field of molecular physics continues in its rapid development, to which especially Sir J. J. Thomson and Prof. Perrin have contributed so important a share. Special mention must be made, in this connection, of the recent work of Dr. Laue at Munich on the molecular structure of crystals, as revealed by Röntgen rays, another experimental substantiation, along a wholly new line, of the atomic theory.

In the domain of chemistry it appeared at one time as if the year 1912 might bring the realization of the commercial production of synthetic rubber. But it appears that we must have patience for yet a while before this important step is fully accomplished. The Eighth International Congress of Applied Chemistry brought a wealth of interesting material to light, yet there is no one particular paper which, for its historic significance, calls for special mention in this retrospect.

In biology perhaps the most remarkable work in hand is that for which the Nobel prize has been awarded to Dr. Carrell—on the survival of excised animal organs, and the growth of such tissues in vitro.

Science shows no signs of lagging; there has been a steady advance along the entire front, though perhaps we have only few achievements of fundamental novelty to record for 1912.

Obituary.

The obituary of the year, in so far as it relates to Science and Mechanics, contains such notable names as those of Lister, Melville, Rotch, Wilbur Wright, and Poincaré. To mention the name of Joseph Lister is to think of the untold blessings of antiseptic surgery; for he was undoubtedly the father of that most merciful art. Before Lister's day, the mortality from major operations varied from 50 to 63 per cent; to-day it seldom exceeds 10 per cent. He was graduated in 1852 and from 1869 to 1877 he held the chair of Clinical Surgery in the University of Edinboro. Long before this incumbency, however, he had done much experimental work to prevent germinal infection of wounds. He used carbolic acid as a germicide, and his first application of antisepsis was made in the treatment of compound fractures. To him we owe the practice of dressing wounds with lint, soaked in carbolic acid, and it was he who first covered wounds, not with cotton, but with sterilized gauze. But for Lister's work the marvelous surgical operations of the present day would be absolutely impossible. In the death of Abbot Lawrence Rotch, the scientific world lost its foremost amateur meteorologist. Rotch was a pioneer in atmospheric exploration, in company with Assman and deBort. Being possessed of an ample fortune, and a cosmopolitan education, he elected to lead a life both scholarly and useful. He founded in 1885 his Blue Hill Observatory, where he developed the technique of the meteorological kite, which has been called the cornerstone of the twentieth century science of aerology, or the exploration of the upper air. This observatory has formed a model for all others, including that instituted by our own Government. The successful use of automatically recording instruments at Blue Hill so impressed General Hazen, the chief signal officer, that they were officially adopted and have been in use in Government stations throughout the country. Mr. Rotch conducted the first American researches with sounding balloons, and he was the first in this country to use the pilot balloon to determine wind velocity and direction aloft by means trigonometrical observations. Nowhere is the value of his work more fully appreciated than in the field of aeronautics, where its practical results will become increasingly manifest as the years go by. The death of Henri Poincaré meant the passing of a great mathematician and philosopher, who by many competent authorities was considered to have been the greatest mathematician of our day. In his literary work, and particularly in his three books, the "Value of Science," "Science and Hypothesis," and "Science and Method," there is to be found that clearness and charm of style which are so frequently found combined in the deepest thinkers of the scientific world. His greatest work was done in the application of mathematics to physics. In the death of Rear-Admiral George W. Melville, the Navy lost one of its most distinguished officers. He is probably most widely known for his heroic efforts to save the remnants of the De Long party in the arctic regions, and this was followed up by able scientific work, done in connection with his later arctic expeditions. As chief engineer of the United States Navy, he was successful in maintaining American marine engine practice abreast of that of the world. In the death of Wilbur Wright, America lost one of its most distinguished and successful inventors. At a time when the world at large, and indeed the majority of the engineers and scientists who wished to solve the riddle of flight, were thoroughly discouraged and ready to believe that a successful man-carrying flying machine was inherently impossible, Wilbur Wright, in company with his brother, Orville, determined to gather up the many broken and separated threads of the investigation, piece them together and carry it on, if possible, to a practical solution. All the world knows how, by making a short, half-mile flight in a motor-propelled man-carrying machine they at last succeeded. The announce- of their success met with the usual incredulity. They returned to their little workshop, and in a few years' time, forced conviction upon an unwilling and astonished world. The universal high regard in which Wilbur Wright was held was due as much to his modesty and absolute sincerity as to the brilliant achievements which stand to his credit.

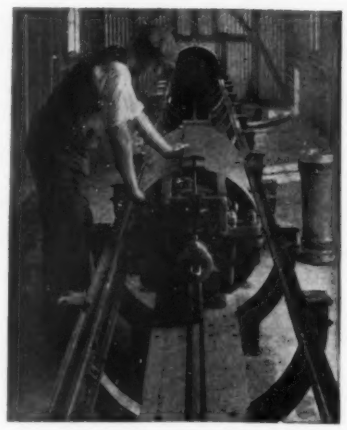
[The review of aviation and aeronautics will appear in our next issue.—EDITOR.]

259761

A Parcels Post Tunnel Railway

Transporting Mail Automatically by a New System

*[The advent of the Parcels Post will probably create a demand for means of transporting large numbers of parcels by some more expeditious and less easily interrupted method than the horse-drawn vehicles or motor cars that must be relied upon for the present at least. The following article describes one system which has been constructed for demonstration purposes.—*EDITOR.*]*

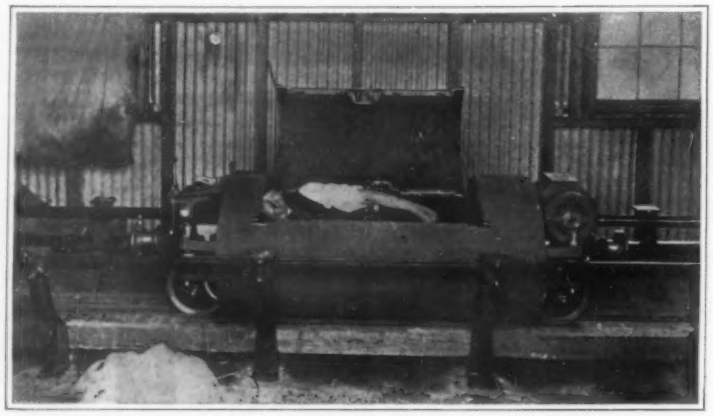


Placing a parcel in the car. The space is sufficient to hold six ordinary mail sacks, or many Parcels Post articles.

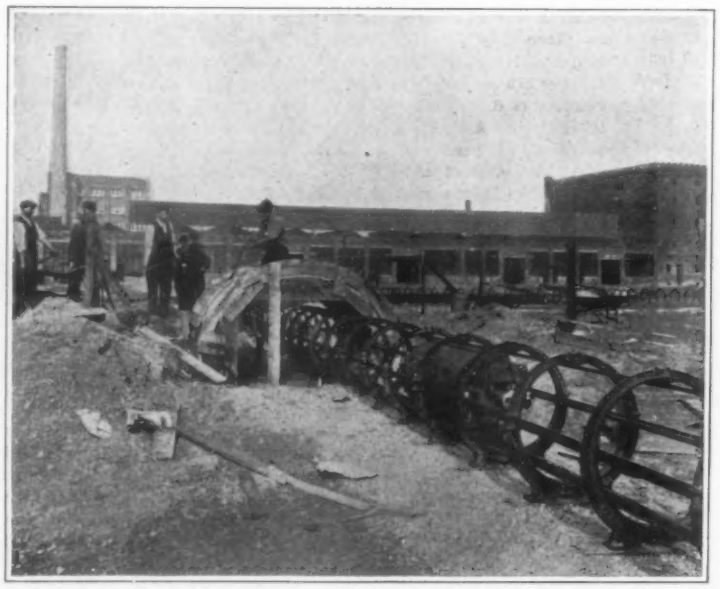
IN five of our big cities, namely, New York, Chicago, Philadelphia, Boston and St. Louis, a large part of the first-class mail is transported between the post office and branch stations and railway stations through underground pneumatic tubes. These tubes are 8 inches in diameter, and the letters, tied up in small bundles, are dispatched in steel carriers, which fit like a piston in the tube, and follow one another in rapid succession. There are some routes—for example, between railway stations, or between general post offices and railway stations—where it is desirable to transmit the mail in sacks or pouches that are too large to be sent through the pneumatic tubes. A commission has recently been appointed by the Postmaster-General to investigate the feasibility and practicability of an underground tube or tunnel between the new post office, located at the Pennsylvania Railroad Station, and the Grand Central Depot, in New York city, which will be large enough to transport the mail in sacks.

An automatic tunnel railway has been designed that can be laid either underground or on the surface, in which small cars are propelled by electric motors mounted on them, in much the same manner as ordinary trolley cars, but with this difference, that there is no attendant on the car to control it. A demonstration plant of this new system has recently been erected on a vacant lot in Cambridge, Mass., opposite the site of the new Technology buildings, by the company that operates the pneumatic mail tubes.

It consists of a galvanized iron building 60 feet long for a station, a tunnel and track nearly a third of a mile in length that begins and ends in the building, and a car to run on the track. Inside the station are located an electric generator, controlling switches, instruments used in making experiments, space for loading and unloading cars, and means of switching the cars from the main track



The tunnel railway car is cylindrical in form, about 25 inches in diameter and 7 feet 3 inches long, large enough to hold an adult. There is one supporting wheel and two guide wheels at each end.



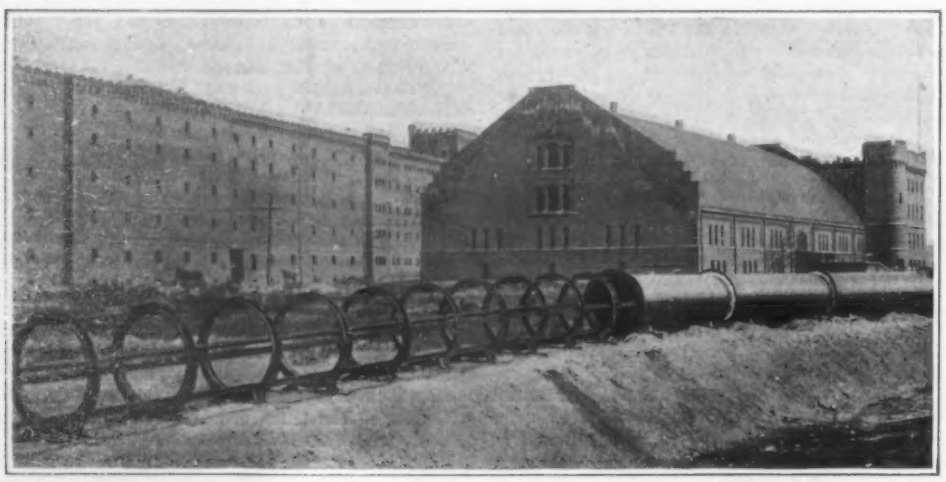
A demonstration plant of the new automatic railway tunnel system. It comprises a tunnel and track nearly one third of a mile long and begins and ends in the station in the background. Car in position on the track.

As the car stops the shoes are unlocked, and the car may be moved out of the way of the following one.

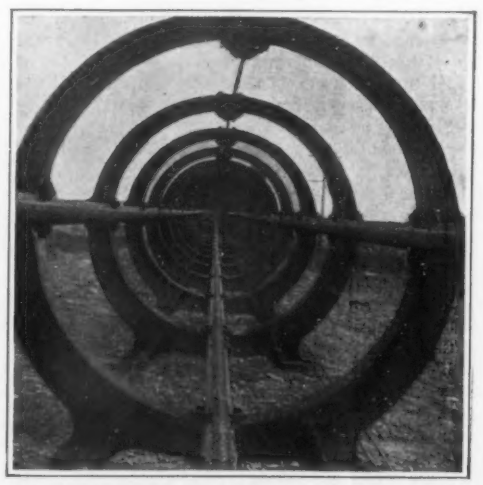
to sidings. Leading out of the building is a tunnel made of 30-inch diameter cast-iron pipe, similar to ordinary water pipe. Four rails are laid inside of the pipe, one on the bottom to support the car, one on each side to keep it in an upright position, and an insulated conductor rail on the top. This pipe or tunnel is 234 feet in length and includes a bend of 90 degrees. The track extends beyond the pipe in a skeleton tunnel formed of cast-iron hoops at intervals of three feet, to which the rails are attached. This skeleton construction is used for the rest of the distance around a rectangular space, terminating in the station. Part of the way it is supported on trestle work to make an ascending and descending grade of 5 per cent. The total length of the track is 1,534 feet and includes four curves of 50 feet radius. No shorter curves or steeper grades would be required in underground lines for regular service. At one point a short section of concrete tunnel has been constructed of elliptical cross-section 6 feet high and 7 feet wide, to show how two tracks can be laid in a single tunnel. In some places a single concrete tunnel is preferable to two cast-iron pipes, and it has the further advantage of giving freer access to the tracks.

The car which runs through the tunnel on the 3-rail track is shown in the accompanying photographs. It is cylindrical in form, about 25 inches in diameter and 7 feet 3 inches long. The space for mail and parcels inside the car is 24 inches in diameter and 4 feet long, sufficient for six ordinary mail sacks, and if used for parcels post would be ample for a large number of miscellaneous parcels. The opening through which the car is loaded and unloaded is closed by a double-hinged cover that can be opened from either side. There are one supporting wheel and two guide wheels at each end of the car. The supporting wheels have double flanges, and one of them is connected through

(Concluded on page 15.)



An automatic tunnel railway that can be laid underground or on the surface, in which cars are propelled by electric motors, in much the same way as ordinary trolley cars, but with this difference, that there is no attendant on the car to control it.



Four tracks are laid on the inside of the railway, one at bottom to support the car, one on each side to keep it upright, and a conductor rail on top.

Scientific Management for Scientists

"The Bridge." The Trust Idea Applied to Intellectual Production

By Professor Wilhelm Ostwald

[*WILHELM OSTWALD must be reckoned among the founders of the modern science of physical chemistry. As the director of the Physico-chemical Institute of the University of Leipzig, he not only himself contributed a lion share toward the upbuilding of this science, but by personal encouragement, teaching and writing, he has done more than is probably realized by all but a few to assist in the making of such men as Arrhenius, Bredig and others. It will be remembered, too, that one of van't Hoff's principal publications appeared in an early issue of the Zeitschrift für physikalische Chemie, then newly founded by Ostwald. Of late years, since laying aside his professional duties, Ostwald has devoted his main efforts to philosophical work and to the support and propaganda of movements relating to various phases of scientific and public activities.*—EDITOR.]

Within the last century or so the world has awakened to a realization of the fact that, of all the social activities of humanity, science, in its broadest sense, is the most important. It is true that as yet the appreciation of this state of affairs has failed to find adequate expression in a practical way, and the so-called civilized nations are to-day spending incomparably more for the maintenance of barbarous military organizations than for the scientific development of problems relating to the culture of mankind, although the former are specifically destructive of energy and pernicious in their action, while only the latter work for energy concentration and upbuilding. The leading spirits of all nations, however, have long since come to a clear understanding of this situation, and accordingly we see numerous institutions, universities, academies, scientific societies, etc., engaged in energetic and effectual activity in the effort of extending the entire field of human knowledge to the utmost.

The phase of this field which has not as yet been satisfactorily organized is essentially that which relates to the character of the knowledge after which we are to strive. Through a perfectly natural process of historical evolution many still regard a mere knowledge of the past, a mere accumulation of facts, as real science, and only slowly, under the pressure of the exigencies of our day, the fact is gaining recognition that all science has one and but one purpose, viz., that of *predicting the future*. Hence every branch of knowledge which claims the right of cultivation by humanity at large, or by an individual nation, must, first of all, justify its existence and prove its claim to social support by demonstrating its social value—which consists in nothing more nor less than its capacity of forecasting the future, and thus influencing it in a direction favorable for humanity at large.

PROFESSOR WILHELM OSTWALD

Thus, for example, as has been clearly shown in the development of medicine in the last few decades, it is now merely a matter of time, and especially of money, whether and to what extent great afflictions of the people, such as tuberculosis, can be exterminated, and humanity thus be freed from one of its direst plagues. The successful war waged against a number of febrile diseases by an investigation of their mode of propagation through the agency of mosquitoes has resulted in the opening up of great tracts of territory on our earth, which were hitherto uninhabitable owing to the prevalence of such diseases, and has thus greatly increased the total population which can find sustenance and be accommodated with some degree of comfort upon our globe. At an expenditure of a few millions of dollars it would be possible to solve in exactly the same manner greater and more difficult problems, and, I repeat it, it depends merely on our spirit of enterprise how soon and how successfully such work will be actually realized.

While the financial means for carrying out work which obviously and directly serves for the welfare of the community, are obtainable with comparative ease, more difficulty is experienced when the effort is made to engage assistance for some abstract scientific work, which can be applied only in the third or fourth instance to the direct amelioration of human conditions. But such science also deserves the most assiduous and careful attention. The question whether a given knowledge can or cannot serve for forecasting the future, need not be restricted to the inquiry whether such prophecy relates to possibilities of direct practical application. Every anticipation of the future may sooner or later become important. A very good example of this is the development of organic chemistry, which originated in Germany in the hands of Liebig, primarily as a matter of purely scientific research, and which has since then made Germany the unquestioned peer in the world's chemical industry.

We can therefore say—speaking very generally—that at the present day a great deal is being done for science. Indeed, at times it almost appears as if too much were being done; for, if we inquire from any worker in one of the large divisions of science about the present state of our knowledge in such field, the answer is almost invariably a complaint that it has become practically impossible for the individual to follow the total production in his science, which has grown to gigantic proportions. While in the first half of the last century one head, such as Berzelius, was capable of completely commanding the entire field of chemistry, so that he was in a position for many years to write his famous "Annual Report" (Jahresbericht) on the advances of chemistry, and to give an authoritative statement of the value of the researches covered, such an undertaking, comprising the whole province of chemistry, is, at the present day, quite unthinkable for a single individual. Even the subdivisions, as organic chemistry or physiological chemistry, have grown so vast, that there is probably no man living at the present day who can command such a division in the same way as, years ago, Berzelius covered the entire field.

What has been said of chemistry is equally true of the numerous other branches of science. Everywhere complaints are made by workers and investigators that it is becoming more and more difficult to obtain a complete survey, even in a comparatively restricted field, of the current scientific production of the day.

The conclusion in brief is that *at present the scientific production exceeds the human capacity for assimilating it.* The ratio which the production of new knowledge bears to our means of disseminating and utilizing the same has become modified to the detriment of the latter task. This is a perfectly natural phenomenon, for the production of knowledge is a matter of such primary importance that it has received very predominant attention on the part of the most enlightened uplifters of humanity. It is only in our own day that the second problem has become more and more pressing, in view of the conditions depicted above. It is true that in certain of the smaller subdivisions of human knowledge, an inner technical organization for the purpose of effecting the assimilation in question has taken place. In particular to chemistry the debt is due, on the part of the rest of the scientific world, for the invention of the "Annual Review" by Berzelius, through which the total production of a year is brought together in orderly sequence and arranged in handy form for future reference. But this method of recapitulation is no longer sufficient, with modern high speed of production, and thus, for instance, in the *Chemisches Zentralblatt* of the German Chemical Society, we see an attempt to communicate to the world at large the current production with the minimum loss of time possible. Such abstracting is very widely developed in the field of chemistry and in other sciences also. The great chemical societies of all civilized nations have each organized a separate abstracting service, which seeks to cover comprehensively the total scientific production of the world in the form of short abstracts.

It will be easily seen that this method is attended with great waste of energy. Not only are there three independent abstracting centers among English-speaking nations—one controlled by the American Chemical Society, another by the English Chemical Society and a third, in a certain measure, by the Society of Chemical Industry—but in addition to these there are at least five or six abstracting agencies in the German language, devoted partly to the entire field of chemistry and partly to large subdivisions thereof; in addition to these there are smaller publications of the same character in French, Italian, Russian, etc. Every paper published is therefore abstracted independently at least ten times, and in this way an immense waste of energy is incurred, which is in no way inherent in the matter at issue, but is purely the result of lack of organization.

What I have stated here from personal knowledge with regard to the lack of organization in chemical science, is seen again in precisely the same way in the other sciences. A few domains in which co-operation is particularly important, such as astronomy and meteorology, are considerably better organized in proportion to their special needs. These organizations are international, but are restricted to certain narrow fields of pure and applied science. Other international organizations, which theoretically cover the whole field of science, such as the Association of Academies, have not

yet acquired a form of activity which should insure for them co-operation with economy of energy in the entire field of science, so that here also the problem still remains to be solved.

Now it so happens that at the present time, in an entirely different field, namely, that of finance, a process is going on which may be regarded as a model for the organization of science and intellectual work. The recognition of the fact that competitive struggle is the most energy-destroying and impracticable of all methods by which opposing wills can be brought into equilibrium, is gaining a stronger and stronger foothold. In place of bitter competitive strife among related industries and commercial undertakings, we see going on everywhere the inverse process of the combination of analogous enterprises for joint collaboration and for the rational distribution of the several functions to such parts as are, through the general force of circumstances, best adapted to perform the same, or, in other words, as are in a condition to carry them out with the highest efficiency in energy consumption.

The process which we thus see going on in the world of economics must necessarily unfold itself also in that field in which the highest possessions of humanity are treated, namely, the field of intellectual labor. The need has become urgent that the total work of this activity of the human race be so organized and brought into harmonious union that no energy be wasted. Energy is wasted where one and the same piece of work is performed several times over, as we know is the case, for example, in the abstracting of current chemical literature, and energy is also wasted where each individual piece of work is not performed under the most favorable conditions with the best auxiliaries available at the present time. An organization of the world's intellectual work would therefore have to solve the problem of exerting a favorable influence in these two directions.

If, now, we ask ourselves how such an organization could shape its activity, the answer is as follows: The *highest* creative productions in science will have to be left as before to individual highly gifted heads, and all that an organization can do here consists in placing the mechanical aids for such work at the disposal of those who are capable of carrying it out. In this direction, a great deal has already been done, as was remarked above, both by private initiative and by governments. Work of this character, then, cannot very well be organized. At the other extreme, on the contrary, there is every possibility of organization. The possibility of thus organizing, that is to say, of establishing some uniform and simple plan, is given pre-eminently in the case of those portions of intellectual work which are simplest and most widely distributed, for the simpler a matter is, the more easily can it be made independent of the individuality of each worker and the more readily can it be replaced by, as it were, factory methods of production and a mechanical mode of procedure. With this point in view, then, an international institute was founded last year in Munich, under the name "Die Brücke" ("The Bridge"),* which deliberately and positively follows the plan of undertaking the organization of scientific work, not from above downward, as hitherto, but from below upward, by, first of all, introducing uniformity and effecting a saving of energy-consumption in those things which can be thus rendered uniform without prejudice to the main task itself. Such are more particularly matters of detail relating to the technique of the production and use of publications and books. By far the greater part of science is, at the present day, recorded in the form of paper covered with writing or print, and consequently a practical and thoroughly efficient "*get-up*" of this fundamental tool of all intellectual work represents a problem of fundamental importance.

Thus, the establishment of a definite scientific scale of size for books and publications of every kind, has, for example, been one of the first tasks undertaken by "Die Brücke." If we reflect how very much easier all labor of writing and printing would be if it were carried out uniformly upon paper in a series of systematically well regulated sizes, how much less space would be taken up by books in our libraries if they all had the same height and breadth, how much easier the management and indexing of all collections of printed documents would be, had we not continually to contend with the differences in the sizes of the volumes, it will be seen that this seemingly trivial matter, in point of fact, lies at the base of all rational organization of scientific work.

The work of "Die Brücke" is not to be restricted to this. Part and parcel of this purely technical organization, which comprises, in addition to the work mentioned, a number of similar tasks, such as the preparation of copies, the cultivation of international language, etc., is also the organization of the intellectual work already accomplished and of that still in progress, as regards its arrangement according to subject, author and institution. "Die Brücke" is planned as a central station, where any question which may be raised with respect to any field of intellectual work whatever finds either direct answer or else indirect, in the sense that the inquirer is advised as to the place where he can obtain sufficient information. Just like a telephone central, "Die Brücke" is intended to place every investigator in communication with every one of his fellow workers and to unite his field of work with every other field, and in this manner ultimately to establish a central for the entire unlimited field of intellectual work, by making use of which every person can automatically find his place in the great organism of the entire intellectual world, working with the minimum waste of energy.

Within the last few years successful efforts have been made in America to introduce the idea of scientific management in all sorts of fields, so that we may expect with confidence to find there a responsive audience when we speak of the organization and systematization of the world's intellectual work. "Die Brücke" has only recently come into existence and is therefore still engaged with preliminary work in Germany, the place of its origin, but we believe that we can confidently assert that our first brother institution, which will work together with "Die Brücke," according to the same principles and with the same aims, will be opened in the United States, the energetic and determined population of which seems best adapted, not only to perceive the unlimited utility of this plan of organization, but also to secure for it a practical realization.

* Postal address: München, Schwindstrasse 30.

The Military Supremacy of the Air—II

By Theodore M. R. von Kéler

(Concluded from the SCIENTIFIC AMERICAN, December 28th, 1912, page 550.)

WHILE France possessed a goodly number of airships of the Lebaudy and Clément-Bayard type several years ago, the rapid development of the swift aeroplane placed the large airship in the background, and it was not until the Zeppelin successes that France awoke to the fact that it had allowed Germany not only to catch up in this particular field, but to set the pace for other nations to follow. The need for large ships capable of staying in the air twelve hours or more at heights above 4,500 feet, and of traveling 500 to 600 kilometers without landing, was felt, and the new law provides for several new ships of not less than 8,000 cubic meters (282,516 cubic feet). During the year 1913, more ships are to be constructed, until the readily available aerial battleship fleet comprises twenty first-class up-to-date ships. Thereafter this number of ships is always to be kept ready for service; old types are to be constantly improved or displaced by new ones, similar to the programme followed in naval affairs.

In the report of Clément to the French Senate on the subject of airship construction, special emphasis is laid on the excellence of the rigid type. The separate compartment idea is also advocated, as utilized in the Zeppelins; while the armament and observation platform of the Zeppelin ships are recommended for use on the new French ships now building.

It is but natural that such extensive plans for increases in the size and number of the ships should demand similar plans for the housing, transportation and filling of these giant aircraft. The big fortresses, Verdun, Toul, Epinal and Belfort are fully equipped as aerial "harbors," while Maubenge, Reims, Chalons-sur-Marne, Chalais-Meudon and La Motte-Breuil are being prepared for the reception of airships.

The great maneuvers of last fall have shown that aeroplanes, in order to be of real value to an army, must be capable of rising from the ground anywhere without the necessity of depending on a permanent base. The first requirement is naturally a ready means of taking the machines apart for transportation; this was one of the tests of army aeroplanes last year, and has been made more rigid this year. It is now required that aeroplanes can be taken from the motor truck, put together and made ready for flight in the space of ten minutes. Specially designed motor cars accompany the aviation companies, carrying spare parts, supplies, wireless outfits and even complete machines in "knock-down" condition.

In order to be absolutely independent of road conditions in a hostile country, some of the aviation companies will be attached to cavalry and artillery divisions, and the horses of the latter will be utilized in pulling the aeroplanes cross-country, where it is desired to save fuel and keep the presence of the machines hidden from the enemy.

What type of flying machine is most suited to military work, is still a much mooted question. The rapid development of the various types renders a final selection impossible at the present time, but two or three-seated machines are preferred to singles. The ministry, quite sensibly, contends that the handling of the aeroplane itself is at present such a difficult and comparatively complicated matter, that no opportunity is left to the aviator to take proper heed of the ground below him, to make sketches or notes, or to receive and send wireless messages. To take care of the most important duties of the military aviator, an observer should take a seat in the machine, whose sole occupation would be the reconnoitering of the enemy's position and an examination of the territory over which the machine flies. For this work only the older, more experienced officers of the general staff are to be used, leaving the youthful lieutenants in charge of the flying.

An aeronautic section of the French army consists of eight aeroplanes and fourteen motor cars, divided into four columns. The first column has two monoplanes with single seats, for fast superficial observation and delivery of orders; the second has two biplanes with double seats; the third has aeroplanes with two and three seats, while the fourth, or reserve section, has one single and one double-seated machine. Each section comprises seven pilots and fifty non-commissioned officers and men.

Besides these "regular" aeronautic sections there are a number of especially fast and powerful machines, capable of carrying two observers each in addition to the pilots, for emergency work. These machines are directly under the orders of the commanding general, are kept near his headquarters, and are able to cover a territory of not less than 100 miles radius.

At the beginning of this year France could mobilize thirteen sections with over 200 available aeroplanes, while before the end of this year no less than 334 machines (30 triples, 160 doubles and 144 singles), valued at $1,600,000, operated by 286 military pilots and 210 observation officers, will be in use. The average life of an aeroplane is fixed at two years and the operating cost $600 annually for each machine.

During the great artillery maneuvers in March of this year, aeroplanes were used in determining the firing efficiency of the guns. Six Blériot single-seated monoplanes, four Farman double-seated biplanes, and three triple-seated Bréguet machines were used in the tests with remarkable effect. While the officers are naturally reticent about the exact results obtained, it has been positively stated that any hostile battery could be destroyed in a few minutes by means of the aeroplane observations, provided it was located within shooting distance. Particularly the aeroplanes with two and three seats did good service, and monoplanes with single seats are not likely to be used in this work.

France pays special attention at present to inventions designed to throw or drop explosives from soaring aeroplanes on moving trains, on bridges, powder magazines, etc. It is, of course, self-evident that the first hostile step on the part of Germany would immediately be followed by a descent of a flock of French aeroplanes upon frontier towns and fortresses. Bridges would be destroyed, railroad tracks demolished and magazines exploded, thereby greatly hampering the German advance after mobilization. Military aviators do not place much value on machine guns designed for shooting into the air, and less on rifles installed on the aeroplanes for horizontal attack. It appears to be the general opinion among them that the mastery of the air must be fought in the air, and that aerial battles will be won by skill in operating the machines and high speed. According to their idea, an aeroplane would have to soar over or above its enemy and then *drop* an explosive on it. To do this, the machine must be high-powered, swift and controlled by fearless expert pilots. And that these considerations have passed the romance stage, and are hard facts of the present day—the next big continental war will show. Germany is watching the activity of the French with eagle eyes, and the successors of Moltke and Bismarck are not likely to permit themselves to be left in the rear in the fight for control of the air.

LIST OF MILITARY AND PRIVATE MONOPLANES AND BIPLANES AND DIRIGIBLES.

	Military		Private.	Dirigibles.
	Monoplanes.	Biplanes.		
France	144	190	500	16
Germany	52	57	150	20
Russia	50	64	50	10
Great Britain	16	36	130	3
Italy	25	16	50	7
Austria	25	5	35	4
United States	....	13	....	....

Arranged in the order of their relative strength up to and including July, 1912; additional machines ordered for delivery in 1912 have been included in this table.

Title Pages for the Scientific American and Supplement

TITLE pages for the last volume of the SCIENTIFIC AMERICAN, the SCIENTIFIC AMERICAN SUPPLEMENT, and AMERICAN HOMES AND GARDENS will be sent free of charge to those subscribers of the three periodicals in question who may wish to bind up the numbers of the last volume.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

High Speed on No. 20 Crossovers

To the Editor of the SCIENTIFIC AMERICAN:

After following very closely the controversy in your columns precipitated by Vice-President McHenry, and the complete knocking out by you of every leg which he attempted to stand on in his argument, my attention is drawn to the inclosed half-page advertisement in the *Springfield Republican* to-day, which I presume is being published extensively in the prominent papers through the eastern part of the country, as a large amount of the stockholders' money is being squandered at the present time in this manner.

The point to which I wish to call your attention and ask for technical information on is in the first paragraph, which has been marked; as in your argument the statement was made that the No. 20 crossovers between New York and Philadelphia daily cared for the trains at full speed. As this advertisement purports to be the second time that the "truth has been told," it would appear as though a misstatement was made; as, without further knowledge, I should much prefer to tie to statements which you made regarding the daily operations on the Pennsylvania. H. E. SCHMUCK.

Springfield, Mass.

[The overturning tendencies of a No. 10 crossover are nearly four times as great as those of a No. 20. The Pennsylvania expresses daily run through No. 20 crossover at far higher speeds than the slow order speed of 35 miles an hour, and they do so without risk.—EDITOR.]

The Reindeer in Alaska

To the Editor of the SCIENTIFIC AMERICAN:

The note about the Alaskan reindeer herds in the issue of August 10th, 1912, calls for some statement of facts as commonly but accurately known throughout interior Alaska. Any success resulting from the introduction of the reindeer into Alaska has been confined entirely to narrow strips of land bordering the oceans, and capable of supporting but a small population. A few, a very few, people have been able to make a living with them. These cases have been quoted repeatedly. On the other hand, continued and persistent attempts throughout the interior have been expensive failures, because of the scarcity of the variety of moss which the reindeer requires. Mere moss can be found almost anywhere, but the only kind upon which reindeer can live is found only occasionally. Consequently, as a draft animal, it is impracticable for the greater part of the country, since long detours must be made in search of food. Such detours are expensive and often unsuccessful. I recall one instance, happening at Anirk, in the winter of 1908 to 1909. The superintendent of schools for the Government came in one day with several reindeer, drivers, etc. They had hunted for suitable moss in vain, and now had to hire native guides to lead the way to the nearest patch, some twelve miles away. Arrived there, they had to shovel snow several hours in order to make it possible for the reindeer to reach their food. The superintendent was at the time on his way to remove the small herd at Holy Cross, which had been a great expense to the Government during that winter, requiring the continual service of between thirty and forty men, whose main duty was to shovel snow off the moss for the herd.

Your article states that "it is expected that the exportation of reindeer meat will soon become an important industry." This is absurd, as can plainly be seen from the fact that thousands of beeves, as well as sheep and poultry, are annually imported to supply the meat needed. There is a continuous but unfilled demand for caribou and reindeer meat. The price of meat here is far higher than in the States, so that a surplus of reindeer meat from the coast herds could much more profitably be shipped here than elsewhere. As it is, the Government itself buys hundreds of beeves to supply meat for the army posts and for the Signal Corps men stationed along the telegraph line.

So it is that, both as a draft animal and as a meat producer, the reindeer has proven a failure in Alaska except in a few localities. For unfrequented trails, the Alaskan dog (Husky or Walamute) is the peerless standby. On the mail trails, hard packed and continually used, stage coaches and horse-drawn "double-ender" sleds prevail. At each station of the Signal Corps will be found a horse or dogs, according to the nature of the surrounding trails. Meat is shipped in hundred-ton lots or driven in from Cordova or Valdez in herds of hundreds. Practically all reindeer herds have been withdrawn from the interior, since careful attempts have shown that their care and keep far exceeded the returns. In view of these facts, counteracting the limited success in a few places, it is little more than a quibble to make such ambitious claims for the Alaskan reindeer herds.

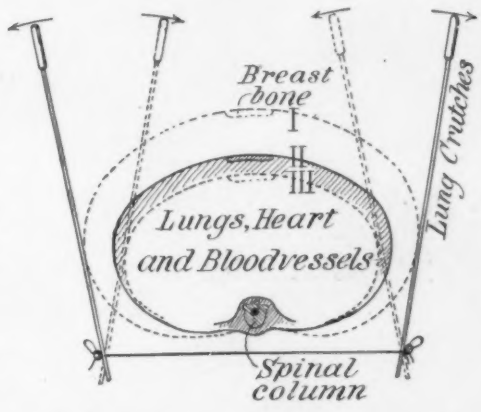
Chena, Alaska. A. W. WILLIAMS.

Artificial Respiration With a "Lemon Squeezer"

To the Editor of the SCIENTIFIC AMERICAN:

Lately a great deal of interest has been shown in resuscitation from electric shock. We live in an age of electricity, and electric accidents are getting to be of every-day occurrence in most places, and, what counts more with the electric companies, we have now a national employers' liability law as well as similar laws in some of the States. These laws take their pet defenses away from the companies and lay them open for damages.

Everybody seems to agree that in artificial respiration must be placed our greatest hope in such cases, but how this is to be done there is a difference of opinion. The thorax or chest resembles a rubber bulb like those we use on atomizers. Now, we all agree that such a bulb can be emptied of air by compression, provided there is a way for the air to get out. After the compression the rubber bulb regains its former size and shape through its inherent elasticity, and in doing so it must suck in air. The chest in my method of artificial respiration is worked just like a rubber bulb. First a way for the air must be provided. If we put an unconscious man on his back, which is the natural and handiest way to work him, his tongue will fall back, close his larynx, and so render his upper air passages, mouth and nose useless. To prevent this, an assistant has to grasp the tongue with a cloth and pull it out to the limit. The neck should at the same time be stretched. If there is no bystander to do this, I put a rolled coat or so under his neck and tie a handkerchief over his pulled-out tongue and lower jaw, knotting it in the back of the neck. Then the common procedure is to compress the lower part of the chest with my hands. In adults I used to straddle them and throw my full weight



Method of using the "lemon squeezer." I, active inspiration; II, deepest unassisted expiration; III, deepest expiration assisted by levers.

on them—175 pounds. There is no doubt in my mind that this is the most efficient method of artificial respiration, but it is so tiring for the operator that it becomes necessary to take turns at compressing, especially since artificial respiration must be kept up for a long time in all such cases.

Of all the mechanical appliances the lever is the simplest and most efficient, and it occurred to me that a modified lemon squeezer would work well on the chest. So I took two boards for levers, and connected them at one end with a cord for a fulcrum. Two boards, size about 19 by 3 by ¼ inches, will do. I shape them with my pocket knife like flat Indian clubs, drill a hole through one end of each, run a string through the hole in one lever, keep the string from pulling through by a knot, and am ready for business.

When anybody is shocked around electric work, he should be put flat on his back, his neck stretched, his tongue pulled out to the limit, and his chest compressed with the levers or "lung crutches" as I call them. They are simply attached as handles to the chest, and the chest worked like bellows. The operator (in electric works the foreman should be so trained) slips the cord fulcrum under the man's chest, runs it through the hole in the other lever, adjusts it with a slip knot to the size of the patient so that the cord is taut behind the back and the handles not quite parallel but a little divergent in front. Then he compresses the chest slowly and easily, keeping time with his own breathing. This he keeps up till a physician arrives and takes charge.

Such artificial respiration is, as far as the change of air into and out of the lungs is concerned, similar to natural respiration, but is not equal to it. Anyhow, it is the best we can do till a physician arrives and tries to restore the action of the heart by other means.

Cambria, Cal. A. C. MULLER, M.D.

Risks in Straightening Rails

To the Editor of the SCIENTIFIC AMERICAN:

Some few years ago I visited a large mill where railroad rails were being made. The person acting as guide showed me all of the various manipulations, and in the end I saw them being made straight by a couple of workmen. The process consisted of sighting along the rail, which was shifted back and forth under a press which was thrown in and out of action as the various kinks and bends were subjected to the pressure to straighten them.

As I stood there interested in the work I saw two rails snap under the pressure exerted. Having noticed a number of articles in the SCIENTIFIC AMERICAN on rail failures it occurred to me that possibly not a few of these failures might be traced to a small incomplete fracture caused at the time of straightening developing into a complete one. I would not attempt to offer any suggestion as to a better way to straighten a rail; but surely any act which would break a rail could develop a crack which might develop into a complete fracture with disastrous results.

Do you not believe that a careful examination along these lines would result in an explanation of why an apparently sound rail suddenly goes to pieces?

Nephi, Utah. H. G. GOULD.

[Our correspondent draws attention to a practice which has been criticised as liable to do permanent injury to a rail. Cold straightening is undesirable, to say the least; the rails should never be straightened when they are below a certain fixed temperature.—EDITOR.]

The Transmutation of the Elements

To the Editor of the SCIENTIFIC AMERICAN:

The interesting article which appeared in the August 24th issue of your valuable paper, "Can the Baser Metals be Changed to Gold?" attracted especially my attention because closely following an article where the same argument is masterly treated by Prof. I. Soddy of Glasgow University.

Let me consider two possible sides of the transmutation problem, viz., transmutation from light to heavier atomic weight elements, and transmutation from heavy to lighter atomic weight elements.

The first side of the problem offers enormous difficulties and is obviously unsolved.

The latter, from your writer's point of view, seems to be solved by Sir W. Ramsay's and Cameron's experiments.

Mr. Rutherford's criticism is reported, and I will add that of Mr. Soddy, who clearly states in the article referred to that: "The energy of sub-atomic changes is thus of the order of a million times greater than the energy of ordinary chemical or molecular changes. The energy evolved from the disintegration of a single atom is detectable by radioactive methods, whereas a million million atoms of any non-radioactive element is a quite undetectable quantity even with the spectroscope. For this reason the identity of the final non-radioactive product of the whole sequence of changes still remains uncertain."

As a matter of fact, Mr. Soddy is referring here to radioactive series disintegrations, not to artificially produced transmutation, but he next points out that: "The fact that it has been found quite impossible, even by the most powerful agencies known, to alter artificially the rate at which a radioactive substance is changing, either to retard or to accelerate it, is obviously the corollary to the well-known impossibility of artificially transmuting one element into another."[1]

It seemed to me necessary to note this discordance in judgments for the proper comprehension of the importance of transmutation, that is going to take the preponderant place among the big problems of modern science, both chemical and physical.

Buenos Aires. RICO S. MARZONI.

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[1] "Transmutation, the Initial Problem of the Future," *Scientia* xxii., 2; pp. 186–202.

The Modern Automobile Torpedo

The Story of a Great Invention

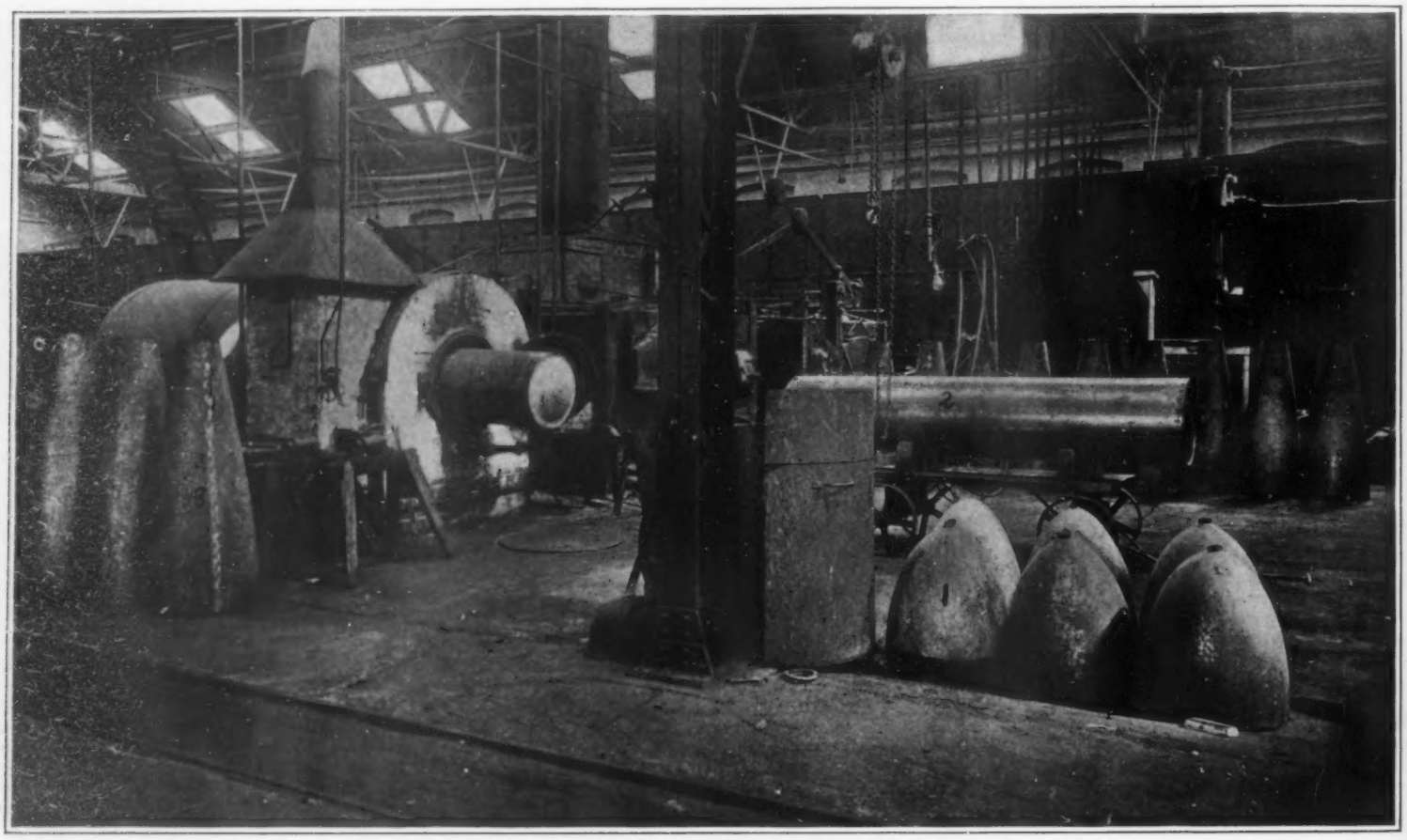
By Robert G. Skerrett

THE modern automobile torpedo so far as its inception is concerned is forty-seven years old. In 1864, Capt. Lupuis of the Austrian Navy, realizing the potential destructive powers of a torpedo capable of self-propulsion, conceived a type of miniature fireship or floating torpedo which could be directed from a fixed base by guiding lines. Capt. Lupuis proposed to propel his torpedo by means of clockwork or steam, but he had not personally the mechanical knowledge needful for the proper development of his weapon. At that time Mr. Whitehead, an Englishman and a man of exceptional mechanical skill, was in charge of an engineering plant at Fiume, and to him Capt. Lupuis turned for assistance. The net result of the association was the awakening of Mr. Whitehead to the field thus offered to engineering cunning. Abandoning Capt. Lupuis' scheme entirely, Mr. Whitehead set about devising a torpedo capable of self-propulsion and self-direction—after once being started on its way—which, unlike the crude surface affair of Capt. Lupuis, should be able to run under water and safe from gun-fire.

From the modest 14-inch torpedo of 1864, with its limited range and speed, we have reached to-day a weapon weighing more than 1,600 pounds and capable of covering ranges up to 7,000 yards—traversing this distance in the remarkably short period of less than seven minutes. This particular torpedo is the invention of Lieut. Hardcastle of the British Navy. In our own service we do not claim the same long range—4,000 yards being the maximum upon which we now place a military value, and the remaining speed at the end of this run is in the neighborhood of 28 knots. The explosive charge of the present-day automobile torpedo varies from 140 to 250 pounds of gun-cotton. The destructive force of a blow of this sort has been amply demonstrated recently by practical tests against the under-water bodies of fighting ships. To-day, the builder of battleships can hope only to restrict the area of under-water damage by subdividing his ship below the waterline into numerous water-tight compartments. One torpedo will probably not be able to sink a dreadnought, but it will be likely to so impair her military efficiency as to make her an easy mark for deliberate annihilation either by gun-fire or further torpedo attack.

Only a few years ago, comparatively speaking, the lateral course of the torpedo was decidedly uncertain, to put it mildly. The range and speed had been greatly improved, but the torpedo still had a way of departing suddenly and mysteriously from its intended course—sometimes coming back at the vessel from which it was sent to the no small dismay of all hands. This was not a pleasant thing to contemplate in time of war when the head of the weapon would be loaded with its violently destructive charge. At this critical stage in the history of the torpedo, the Obry gear was invented. Briefly, the Obry gear consisted of a gyroscope placed within the torpedo and so connected by intermediate power mechanisms with the directive rudders that the weapon could be held to a fairly straight course or, more properly, to a sinuous one consisting of a series of flattened curves alternating from right to left. The original Obry gear had a spring impulse, its directive force rapidly diminishing from the instant of starting, and it became quite useless after the torpedo had run something over a thousand yards. Realizing the value of the gyroscope, however, other minds promptly set about improving this instrument of lateral guidance. To begin with, the adoption of ball-bearings, nicer balancing, and the refining of various moving parts made it possible to lengthen the directive period of the gyroscope as well as to increase its sensitiveness—thus insuring a more reliable run and a speedier one by flattening the sinuous course. The next developments introduced an air-impulse, turbine-driven gyroscope, and then an electrically-driven Obry followed. These have done away with the shock of the original spring impulse and have naturally greatly increased the directive value of the gear, besides making it possible to fire the torpedo from a broadside and cause it to swing automatically through an angle of 90 degrees toward a target dead ahead. From a weapon that was a menace to friend and foe alike, the installing of the gyroscope has revolutionized the automobile torpedo, making it under some conditions even more certain of hitting its mark than that possible with the biggest of our modern guns.

For years the wonderfully compact and efficient



Sweating in the ends of the air flask or "middle body" of a torpedo.

No. 1 is the forebody or head of the torpedo; 2 is the "middle body" or air flask. 3 is the after body of the torpedo.

THE MODERN AUTOMOBILE TORPEDO

Some time in 1864 Mr. Whitehead built in secret his first torpedo. This weapon was a relatively modest effort: having a diameter of 14 inches, weighing but 300 pounds, and carrying a charge of but 18 pounds of dynamite. The motive power was compressed air stowed at a maximum pressure of 700 pounds per square inch, and the torpedo was capable of making about 6 knots an hour for a short distance. As soon as this torpedo was subjected to test in the water, Mr. Whitehead was brought face to face with some of the harder problems of his undertaking. One of these was the task of properly controlling the submerged running. Instead of keeping at a uniform depth, the torpedo divided its time uncertainly between the surface and the waterbed, and it was seemingly impossible to keep it within the desired bounds. After four years of patient experimenting, Mr. Whitehead evolved his "balance-chamber"—for years guarded by every effort to keep it secret—by means of which the submergence of the torpedo became automatic: the movement of a pendulum combined with hydrostatic pressure serving to actuate certain controlling mechanisms which, in their turn, operated the diving rudders. The Austrian government was the first to give official recognition to Mr. Whitehead's work, but was not in a position financially to obtain exclusive rights to the invention.

All the while that the torpedo was improving in military value, the range of modern guns on shipboard was likewise undergoing substantial increment—making it possible for ships to fight at greater distances, and the torpedo expert realized, despite all that had been done to make his weapon more effective, that both the range and speed of the torpedo must be further increased if it were to meet properly the changed conditions. This was a staggering realization, because there were difficulties in the way of making a larger torpedo susceptible of easy handling, and it was not practicable to add much either to the capacity of the air flask or to the pressure of the energy stored therein. At this critical stage, American inventive skill found a way to surmount the obstacle. Mr. Frank M. Leavitt, of the E. W. Bliss Company, made the startling proposal to heat the air stored in the flask, and thus to three-cylinder Brotherhood engine was the best available motor for the automobile torpedo; but even with its progressive developments it had the inherent limitations or drawbacks of the reciprocating engine, and it was only logical that the torpedo builder should cast about him for a motor capable of utilizing still better the power stored in the air flask. The turbine was the natural solution of the difficulty.

cause its expansion and multiply its propulsive capacity. The first American development of the superheater for this purpose consisted of means by which alcohol could be burned within the air flask—the heated air passing thence through the valve system to the engine or turbine and, while still relatively warm, passing outboard through the exhaust. Apart from propulsive advantages, superheating obviated another objectionable feature of the older system in which the changes of temperature were so great—due to the rapid expansion of the compressed air—that the exhaust was frequently far below the freezing point. This caused the lubricants to congeal and, in turn, impaired the action of moving parts. The British development of the superheater omitted the alcohol flame from within the air flask and put it between the reducing valve and the motor. This was an advantage in some ways: it did not require the heated air to pass through the delicate valve system, it fed into the engine the air at its most efficient temperature, and it made possible a nicer control of the pressure at the engine or turbine. However, like all good things, it had a drawback from a military point of view. When the air flask of one of our torpedoes is fully charged, the actual weight of that compressed air amounts to something like 191 pounds. The reducing valve, which regulates the pressure and supply of air to the motor—standing sentinel between the air flask and the propulsive mechanism—is designed to maintain a feed pressure of 300 pounds for the turbine impulse. When the pressure in the air flask approaches 300 pounds, the run of the torpedo is substantially at an end so far as its useful military speed is concerned. As the air in the air flask expands due to its gradual escape to feed the motor, the temperature is lowered sometimes even to below zero, and this remaining air is incapable of expelling itself from the flask for the purpose of effecting the propulsion of the torpedo. It has been found that when the superheater is outside of the air flask, of the total weight of 191 pounds of stored energy, not more than about 148 pounds are utilized. Again Mr. Leavitt's ingenuity has supplied a remedy. Instead of heating the air within the flask during the entire run of the torpedo as he first did, he, too, heats the impulse supply outside and between the reducing valve and the turbine, but, in order to make use of more of the stored air than possible heretofore, he causes the ignition of an alcohol flame inside of the flask toward the latter part of the run. By this means he is able to use to good effect 174 pounds of the original 191 pounds of the compressed air—thus increasing the range and the maintenance of higher speeds throughout the longer run.

Without giving away state secrets, the following table will show what the superheater has made possible in the case of an 18-inch torpedo. These figures are very instructive:

Speed in Knots.	Air Unheated.	Air Heated.
At 1,000 yards	35	43
At 1,500 yards	30	40
At 2,000 yards	28.25	38
At 3,000 yards	23-24	32
At 4,000 yards	18-20	28

This article has reviewed only the more startling features of development in the so-called Whitehead automobile torpedo, but it must not be imagined that there have not been numerous other directions in which the weapon has been modified and bettered to overcome the cunning of the defense. These, however, contributing as they do to improve effectiveness and precision of action in one direction or another, are matters of detail which cannot be touched upon within the space of this contribution—interesting as they undoubtedly are.

Floating Islands

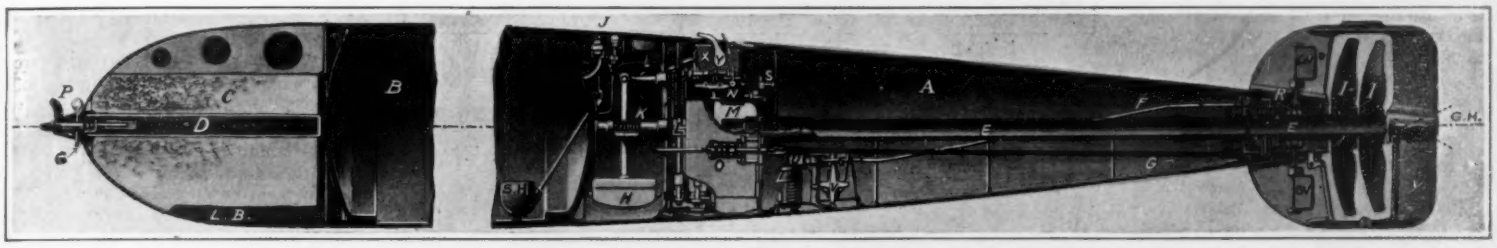
THE imagination of man has always been impressed by floating islands. In ancient times such islands were regarded with superstitious reverence; and the romantic story of Delos—the natal isle of Apollo and Artemis—is but one of many cases recorded in classical literature of vagrant islands in the sea. Pliny says that in the lake of Vadimonis there is a dark wood which is never seen in the same place for a day and a night together; and he describes the islands called Calaminæ (i. e., "made of reeds"), in Lydia, which were not only driven by the wind, but could be pushed about from place to place with poles.

Floating gardens—some natural and some artificial—have flourished in many parts of the world from early times. They are particularly advantageous in regions exposed to floods, where a garden planted on *terra firma* would be ruined by these occurrences, while the floating garden is undisturbed by the rise of the waters. The famous floating gardens of Kashmir are a case in point.

The lake of Xochimilco, near the city of Mexico, is nearly covered with floating gardens, called *chinampas*, on which are raised vegetables and flowers for the city markets. They are formed of floating masses of water-plants, covered with soil and secured by poplar stakes. The latter take root and surround the islands with living hedges.

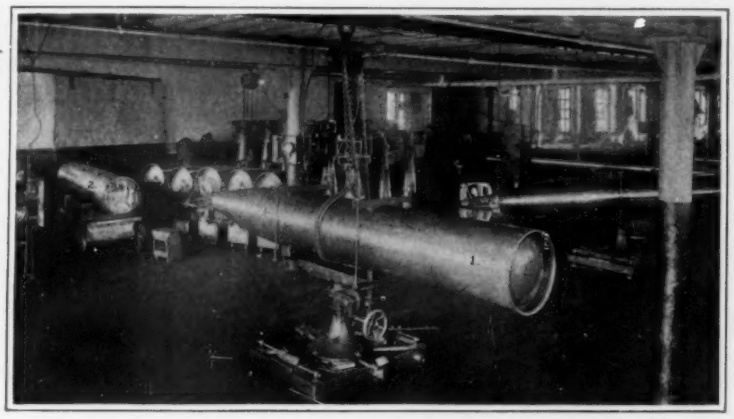
Among the largest of natural floating islands are those formed by tangled masses of trees and brushwood carried down by great rivers. On the Mississippi and its tributaries these islands are known as "rafts." One of the most remarkable of these rafts began forming in the Atchafalaya, one of the lower arms of the Mississippi, in 1778, and gradually increased until by 1816 it had extended to 10 miles in length, over 600 feet in width, and 8 feet in depth. Although it rose and fell with the water it was solid enough to support the growth of trees, some of which were 60 feet in height. This vast obstruction was finally removed by the State of Louisiana at great expense. The work began in 1835 and lasted four years. In more recent times a great raft in the Red River completely blocked the channel for 45 miles, until it was removed by the National Government.

Where a mat of vegetation borders the seashore the action of waves sometimes breaks off large islands. This was probably the origin of a remarkable floating island which was first seen in the Atlantic Ocean about 400 miles east of the New Jersey coast in July, 1892. Its area was about 9,000 square feet, and it bore trees 30 feet in height. When again seen in the following September it had traveled over 1,000 miles.



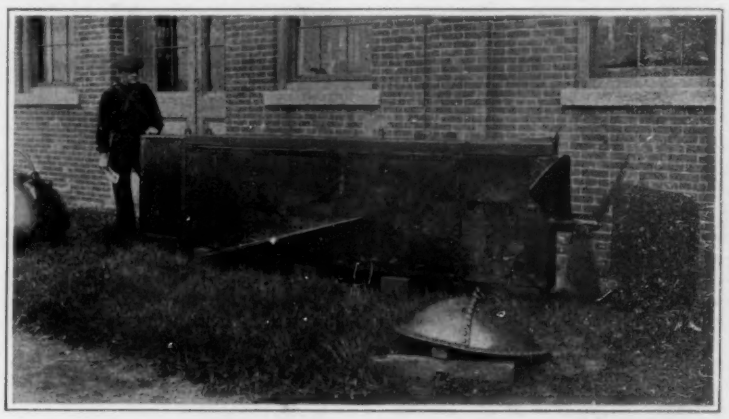
A longitudinal section through a Bliss-Leavitt torpedo, showing the disposition of the explosive, the driving machinery, and the propellers.

P, plunger or striking rod. *G*, safety-pin. *C*, guncotton charge. *D*, detonating charge. *B*, air-flask. *J*, charging valve. *K*, hydrostatic valve. *H*, pendulum. *M*, turbine. *N*, submergence control mechanism. *S*, submergence valve. *S H*, superheater. *X*, valve case. *Y*, air lever. *O*, immersion servo-motor. *L*, pressure regulator. *V*, gyroscope. *T*, gyroscope impulse. *U*, servo-motor. *G*, *V*, rudders for horizontal control. *G*, *H*, rudders for vertical control. *F* and *G*, rudder controls. *E*, *E*, propeller shaft. *I*. *I*, propellers. *R*, shaft gearing. *A*, after-body. *L*, *B*, ballast.



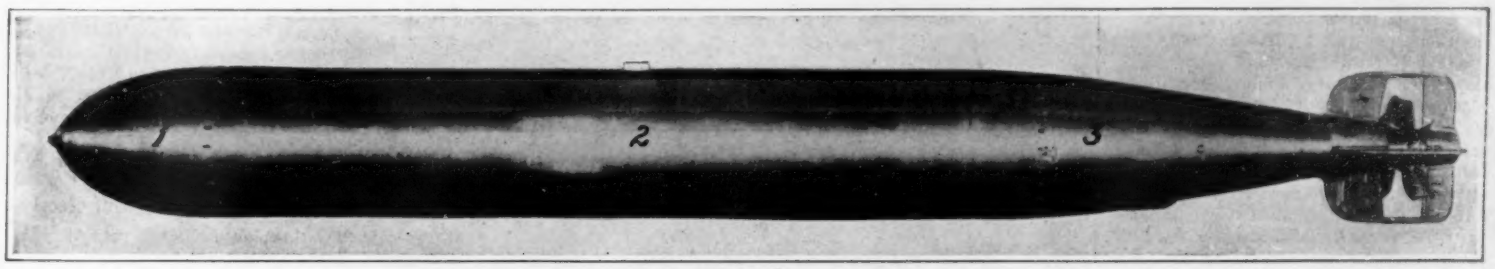
Testing stand used in ascertaining the accuracy of the gyroscope's control, which has revolutionized the automobile torpedo.

No. 1 shows the torpedo without the head attached. No. 2 shows the middle body and the after end of the air flask with superheater flasks in position.



Ericsson's automobile torpedo of the 70's, built in this country, and tested at the United States Naval Torpedo Station at Newport.

This dirigible torpedo was designed to rival the Whitehead and the Lay torpedoes. It never survived the experimental stage. It was driven by compressed air.



One of the latest types of the Bliss-Leavitt torpedoes, showing the three separate sections of the torpedo in their assembled condition ready for service.

THE MODERN AUTOMOBILE TORPEDO

Turntable for Cars

IN the majority of garages there is very little room for the easy maneuvering of automobiles and a great deal of time is wasted in trying to turn a car about, particularly if it has to make a right-angle turn to reach the elevator which will carry it to the shop. The accompanying picture shows a special form of turntable, adapted to overcome the necessity of tedious maneuvering. The turntable is similar to that used for locomotives. It may be rotated by a single man by using a bar to engage any one of the several small holes in the outer edge of the table. The table itself is built of reinforced concrete and hence is proof against water and fire. The diameter of the table here shown is fourteen feet, so that it will take the largest touring car. It has been found of great convenience when adjustments or repairs must be made, for the car can be swung around without any trouble to the best position to obtain all the available light.

New York's Cave of Stalactites

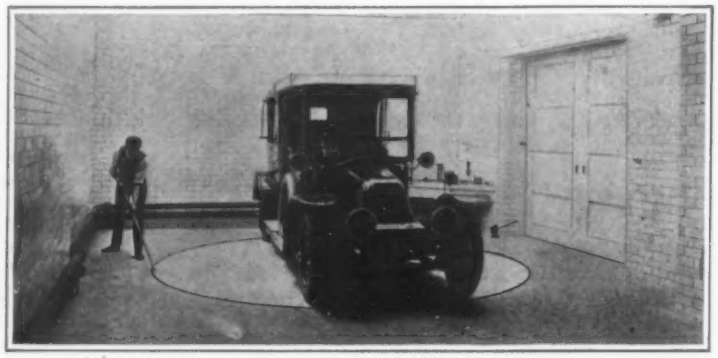
ONE of the most noteworthy forthcoming exhibits in the Mineral Hall, at the Museum of Natural History, New York, will be the representation of a beautiful cave of stalactites and stalagmites. This will be a reproduction of almost an entire cavern recently discovered in the Copper Queen Mine, at Bisbee, Arizona. Here, a quarter of a mile below the surface, during the mining operations of blasting for copper, a spacious chamber was uncovered containing a series of terrace-like grottoes adorned with a wealth of magnificent and many-colored stalactites and stalagmites. Dr. Douglas and the mining company placed the find at the disposal of the museum. Dr. Edmund Otis Hovey, Curator of Geology and Invertebrate Palæontology, with three assistants visited Bisbee, to collect and bring back the original material so as to form an exact reproduction of the Arizona cave. A half a hundred boxes, containing the choicest formations from the walls, floors, ceilings, etc., were brought back. They weighed from one pound to nine hundred. The delicate task of setting up the pieces in the cave at the museum is being executed by Mr. William Peters, artist of the museum staff, who accompanied the expedition to Arizona.

A steel frame, 12 feet high by 8 feet wide, forms the outside of the cave, which will be covered with limestone blocks, taken from the mountain under which the cave was found. These wonderful formations of stalactites and stalagmites are made through the evaporation of percolating waters. The most striking feature of the reconstructed cave will be a stalagmite 3 feet in diameter and 3½ feet high, of a beautiful green color, and weighing about 900 pounds. This stalagmite is remarkable on account of the radiating clusters of pointed calcite crystals thickly set all over it but diminishing in size from the bottom of the column upward.

Electricity and Diet

SCIENTISTS have been looking for some method of replacing the multiple aliments which are needed to keep up the human body, by food in a concentrated state, so that it could be absorbed with less fatigue. On the other hand, a French scientist, Prof. Bergonié, claims that electricity will solve the problem. We have already mentioned some results which he obtained in this direction, according to the account presented by him to the Science Advancement Congress. Since then he has continued his researches and arrived at results which have almost a sensational character. Before this he simply proposed the idea that electricity could be made to replace food, that is by adding to the heat energy absorbed by the body, so that less food need be taken into the system. At present he is making actual experiments which appear to prove this conclusively according to his communication made to the Academy of Sciences. The experiments were made during the last few months at his laboratory at the Bordeaux University and fully confirmed his theories on the subject. His method, known as "diathermy," or application of low tension and high frequency currents to the human body, is able to make up for a part of the alimentation of the system by furnishing a large amount of heat to the body, instead of producing the heat from food materials which need to be consumed or indeed burned in the system, this giving rise to overwork of the physiological organs of the body. Such electric currents, as Prof. Bergonié says, will pass through the body without causing the least feeling; and with a current of 2 to 3 amperes strength and a voltage of 1,000 to 2,500 volts per hour about 1,000 calories of heat can be furnished per hour, this being over one third of the daily food ration. The following test will bring out the remarkable results which can be obtained by this method. He applied the electric treatment to a man 5 feet 10 inches high, whose weight before the treatment was only 110 pounds. The patient ate a great deal of animal food, but was in very bad condition, as he could not walk over 300 feet without needing aid. He was unable to work and was very sensitive to cold. After a series of treatments of 40-minute duration by the electric method, this corresponding to an absorption of heat equal to about 1,700 calories each time, the patient began to improve rapidly, and at the end of the treatment he gained considerably in weight. In fact, he then weighed as much as 140 pounds, which makes a gain of about 30 pounds. Dr. Bergonié states that the patient can now walk for hours without fatigue, and his physical vigor is restored to the normal. He is able to stand all degrees of heat and cold, and his general appearance is very good. The author considers that the time is not far distant when all troubles due to insufficient nutrition will disappear under a series of electrical treatments by high frequency currents according to the general method of M. d'Arsonval.

Readers are invited to contribute photographs of novel and curious objects, unique occurrences and ingenious contrivances. Such as are found available will be paid for promptly.



An automobile turn-table for garages.

The original cave in Arizona.

Reconstructing the cave in New York.

A rotating ice disk, naturally formed.

A Frozen Whirlpool

WE have received from a reader in Schenectady, New York, the accompanying photograph of a most unusual ice phenomenon. As the result of rotary currents in a mill pond, a large circular piece of ice nearly six feet in diameter was formed and kept separate from the main body of ice, owing to its continuous motion. The disk was almost a perfect circle, and moved slowly from left to right. This phenomenon occurred last winter. The unusual condition continued for several days until the ice had obtained a thickness of nearly two inches.

L'Illustration.

Statue of Marcus Aurelius removed from his horse for repairs.

Marcus Aurelius Unhorsed

THE noble statue of Marcus Aurelius in the Capitol Square of Rome has suffered severely from the ravages of time. Recently it was found that the precious bronze was urgently in need of repairs. The only thing to do was to remove the Emperor from his horse, and take him to the museum of the Capitol, where the rents in his garments and the scars on his limbs could receive proper scientific treatment. A scaffold was built over the statue and the Emperor was firmly bound by the legs and chest and then lifted from his horse by means of suitable tackle. Our illustration pictures him as he is being lifted and shows that even in this trying position he was not lacking in stoic gravity. While the Emperor was undergoing repairs at the museum his horse was completely boxed in by a temporary wooden shack. When the figure was removed from the horse there was considerable agitation on the part of a faction of young Italians who were anxious to have him replaced by a statue of Cæsar. Fortunately for the memory of the great Marcus Aurelius, this agitation was unheeded by the authorities.

Power of a Microscope

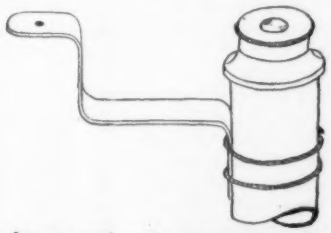
By C. W. Nieman

AMATEURS who have a microscope miss a great deal of the pleasure and interest to be derived from its use unless they are able to find the magnifying power of their instrument and to measure objects with which they are working. It is surprising how much more intimate an acquaintance with an animalcule or portion of an insect is obtained if we are able to say that it is 3/1,000 inch in diameter, or whatever else its dimensions may be.

In order to measure objects under the microscope it is first necessary to find its magnifying power, or, in case the instrument has several objectives and eye-pieces and the tube can be changed in length, to find the magnifying power under the various conditions in which it is used. All the methods the writer has seen involve the use of an object of known length which can be observed under the microscope. This usually consists of a pair of lines ruled on a glass plate at known distance apart, and can be bought for a couple of dollars. This outlay, however, is unnecessary if the following method is employed.

Take a good watch and measure the exact radius of the hour hand, that is, from the tip to the center of the pivot. Suppose this is found to be 0.57 inch. Then the path of the point in 12 hours will be $2 \times \pi \times 0.57 =$ 3.58 inches. Therefore, it will move 1/100 inch every 2 minutes and 1 second. If the crystal is opened and the microscope focused on the tip of the hour hand, in 2 minutes and 1 second it will have moved 1/100 inch, and will fill the same purpose as the lines ruled on the glass. To the side of the barrel of the microscope fasten a piece of sheet metal with a small hole in one end and bent as shown. The distance between the hole and center of the eye-piece must be the same as the distance between the experimenter's eyes. On the table below the hole fasten a ruler running across the table, i. e., forward and back from the operator and exactly 10 inches from the hole. This 10 inches is the arbitrary distance selected in this country for such measurements. The watch must be so placed that the hour hand is moving directly toward or directly away from the operator. Now, upon looking in the microscope with one eye and through the hole with the other, the watch hand and the ruler will appear to be one on top of the other. Note the exact point on the ruler where the hand is at any instant. Then let 2 minutes and 1 second pass and again note the position. If the distance moved is 2.5 inches it will mean a magnification of $\frac{2.5 \text{ inches}}{0.01 \text{ inch}} = 250$ diameters. A little practice will enable a person to hit the time very closely. This can be repeated for various conditions, for low power lenses a greater distance than 0.01 inch being taken and for higher powers perhaps a shorter one.

The next thing is to construct a scale for the measurement of microscopic objects. The scale reads in thousandths of an inch, but each thousandth inch is magnified according to the power of the microscope. Thus, where the magnification is 250 diameters the "thousandths" will be ¼ inch apart. The proper length and divisions for the scale (or scales in the case of several objectives) can be figured and can then be drawn on a strip of cardboard. To measure an object it is only necessary to put the scale in the same position as the ruler in the first experiment. The object will then appear right on top of the scale and can be measured as easily as a carpenter measures a board. *Caution*: Always hold the scale at right angles to the nearest edge of the table. If it is laid parallel to a line connecting the hole and the eye-piece it will be nearly impossible to make a measurement. This is easily proved by trial. Also remember that the scale must be 10 inches from the hole. If this is an inconvenient distance owing to the shortness of the microscope any other distance can be adopted, as 8 inches, but in this case each division must be 8/10 as long as for the regulation distance.



Device for measuring the power of a microscope.

How to Remove Black Paper Strips from a Film Back

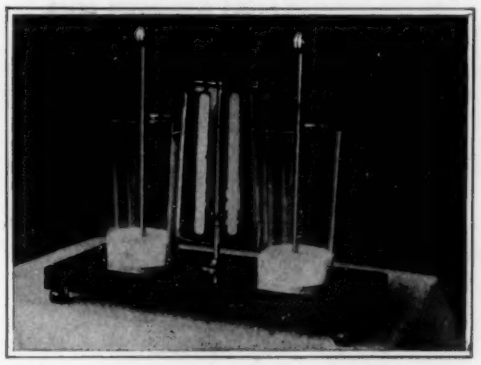
By Stanley P. McMinn

IN removing the black paper strips from a film pack such as commonly is used by countless numbers of amateur photographers, trouble not infrequently is experienced by reason of the paper tearing off before it has been completely withdrawn. Under ordinary circumstances, in order to nullify the effect of the remaining piece of black paper, it is necessary to pull out the next flap, thereby sacrificing one exposure. It is quite possible, however, to remove the section of black paper without destroying the exposure or disturbing the film remaining in the pack, with the aid of the gummed portion from an envelope. The envelope flap first should be trimmed to the width of the film pack, an envelope made of fairly heavy paper would better be used, though almost any thickness will serve the purpose. Then if the gum is moistened, which by reason of the slippery nature of the mucilage will operate to lubricate it, little difficulty will be experienced in slipping the improvised "fish" down between the torn-off paper and the next black strip in the pack. Care should be taken, of course, to ascertain that the gummed portion of the envelope comes in contact with the torn paper and not with the next black strip. The envelope should be permitted to remain in position for about 10 minutes, or until the gum has had time to harden thoroughly, when it will be a simple matter to draw out the torn strip by grasping the free end of the envelope.

An Interesting Static Electric Motor

By H. B. Dailey

FOR exhibiting in an entertaining way the effects of static electric attraction and repulsion, and for stimulating an interest in the observation and study of these phenomena, there is perhaps no form of demonstration apparatus more effective than a static electric motor. While examples of static motors have occasionally appeared, the degree of mechanical skill involved in their making has usually been such as to discourage attempts at amateur construction. The features of extreme simplicity possessed by the efficient little motor here described should therefore commend it to the home experimenter.



The "tumbler" static electric motor.

The apparatus employs three large equal sized tumblers of thin blown glass. The central tumbler, inverted, revolves upon a pivot-pointed stem of 3/16 inch steel wire whose upper end enters a small indentation drilled in the exact center of the tumbler's bottom. A lower bearing is provided by fitting into the mouth of the tumbler a centrally apertured disk of stiff mica through which the supporting rod passes, the disk being secured in place with a little shellac applied to its edge. To keep the pivot stem from wearing the mica, a copper cent drilled to an easy running fit for the rod is attached to the mica disk with sealing wax. The tumbler, which is raised about an inch above the base, has cemented with shellac upon its outer surface eight equally spaced vertical strips of tinfoil 5/16 of an inch wide, with rounded ends, and of a length about 3/4 of an inch shorter than the length of the tumbler.

Upon opposite sides of the inverted tumbler and quite close to it are placed two similar tumblers, right side up, their bottoms fixed with shellac into snugly fitting recesses bored in the wooden base of the instrument. Each of the fixed tumblers has cemented upon its inside surface exactly facing the central tumbler a vertical strip of tinfoil ⅞ of an inch wide, rising from the bottom of the glass up to within ⅝ of an inch of the upper rim, the lower ends of these tinfoil strips, or field strips as they may be termed, being electrically connected with vertical knob-tipped metallic rods fixed in the centers of the outer glasses with a setting of plaster of Paris.

Lastly, from one of the upper corners of each of the field strips (from corners diagonally opposed on the field, strips face each other in the apparatus) a narrow tinfoil extension ⅛ of an inch wide rises vertically to the rim of the glass over which it passes, and terminates ¼ of an inch down the outside of the tumbler. On connecting the two balls at the tops of the vertical rods with the opposite poles of a static machine, the central tumbler immediately begins a rapid rotation which continues to increase until the apparatus fairly hums.

In starting, the foil sectors on the central tumbler are at first attracted by the charged field strips within the outer glasses. As the sectors move into position opposite the field strips they receive sparks from the latter and become similarly charged, when repulsion ensues. Moving forward with the rotation of the tumbler they soon come within the influence of the oppositely electrified field strip on the other side and are strongly attracted, until, as they pass the field strips, their electrification is reversed and the cycle is repeated. The moving sectors receive their sparks from the tips of the field strip extensions whose lateral displacement prevents the electrification of the sectors until the latter have come opposite the exact center of the field strips. The "tumbler" motor is a fascinating little machine to watch in operation, and when one sees its vigorous rapid action it seems incredible that the motive power is static electricity. The instrument operates satisfactorily from a very small static machine.

To Fill a Barometer Tube

By Henry H. Riggs

AMATEURS who have to fill or refill their own barometers are sometimes greatly troubled by the residuum of air which will remain in the tube in spite of all precautions, and spoil the vacuum and the accuracy of the barometer.

The following will be found a very helpful trick, though it will not take the place of other precautions for keeping mercury and tube clean:

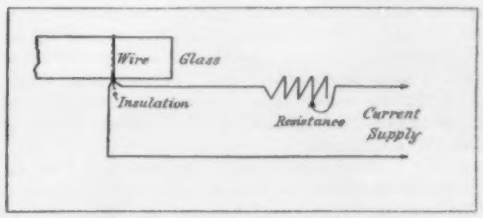
Take a piece of soft-iron stove-wire, and wind half a dozen turns around a large nail or rod, of such a size that the coil will just slip inside the barometer tube. The coil must be a close one, with no spaces between the turns. Straighten the rest of the wire out so that it lies parallel to the axis of the coil. Finally, wind a piece of cotton yarn in the coil so that it lies snugly in the groove between the turns of wire, bring one end through the coil, and tie.

This makes a hollow swab which just fits the tube snugly. After the mercury has been poured into the tube, hold the latter upright, mouth up, and slowly run the swab down to the bottom and out again several times. Any minute bubbles of air that adhere to the surface of the glass will be wiped off and carried away by this swab, leaving the tube clean and dry and absolutely full of clean mercury.

An Electrical Method for Glass Cutting

By Philip Edelman

THE following method will be found useful for cutting off bottle necks, the ends of incandescent lamp bulbs, glass tubing, and similar pieces. Obtain a piece of fine resistance wire, preferably of some non-deteriorating alloy such as is used in electrical heaters. Common iron wire or valve wire such as is used by repair men will be found satisfactory. Wind one turn of the wire around the part to be cut, taking care to insulate them at the point where they meet. Asbestos or mica will be satisfactory for this purpose. One turn is sufficient and should be wound tight. Now connect this short piece of wire in circuit with a suitable current. This may be A. C. or D. C. from a current tap or from a battery. If a current tap is used a resistance should be connected in series so as to avoid a direct short circuit on the line. If a battery is used it must have sufficient voltage and amperage to heat the wire. Allow the wire to come nearly to a white heat for a short time and then plunge the glass piece into some cold water. Holding the piece under a water tap will also do. The piece should then break cleanly at the point covered by the wire. The same general method can doubtless be applied to a variety of uses. There seems to be a limit to the size of a piece which can be cut in this manner, however. The worker can soon find the limits and then use the method to the best advantage.



Cutting glass with electric heat.

The hot wire heats the glass in a restricted place which can be regulated by the worker as desired, and the heat does not spread all over the glass so as to cause an irregular break. The glass coming into contact with the cold water is subjected to considerable strain at the heated portion and consequently either breaks or cracks.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

The Flywheel Motor Starter

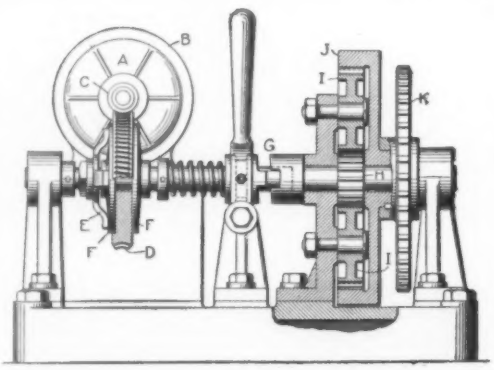
ONE of the first things in physics that the schoolboy learns is that the purpose of a flywheel is to equalize and steady the motion of the reciprocating steam engine. Owing to its inertia it overcomes any tendency to acceleration while its momentum tends to overcome any tendency to retardation, and so the power shaft is made to run smoothly at a constant speed. But somehow one does not usually grasp the idea that the wheel is really a storage battery of mechanical energy. No doubt that is why so little use has been made of this battery except for the mere balancing of variable powers and loads.

Not long ago an inventor was confronted with the problem of starting a large gas engine which he used for his lighting plant at his country home. The engine was supposed to be started by compressed air, and for this purpose two large air tanks 20 inches in diameter and seven feet high were provided, together with an air compressor with a bore of five inches, which required an expenditure of 1½ horse-power for an hour and a quarter to fill the tank at sufficient pressure to start the engine. If for any reason the gas engine failed to start on the compressed air, the work had to be done by hand. This happened so frequently and it was so hard to turn the engine over that the inventor decided to use an electrical means for starting the motor. Not wishing to install a large motor it occurred to him that he could secure the desired results by using a small motor driven at very high speed and furnished with a flywheel whose momentum would be sufficient to carry the engine over the peak of the load, i. e., the compression point. So he built a small motor of one third horse-power and furnished it with a flywheel 8 inches in diameter and weighing eight pounds. This was connected by stepdown gearing to the engine, 250 revolutions of the electric motor producing one revolution of the engine shaft. By connecting up the motor to a small storage battery he was able in ten seconds to make it attain a speed of 8,000 revolutions per minute. A clutch was then thrown, connecting the motor to the engine, and the stored-up energy in the flywheel expended itself upon the engine at the compression point, turning it over easily. Once the parts were in motion the baby motor was able to keep the engine shaft turning, as the flywheel would store up sufficient energy for this purpose between compression points.

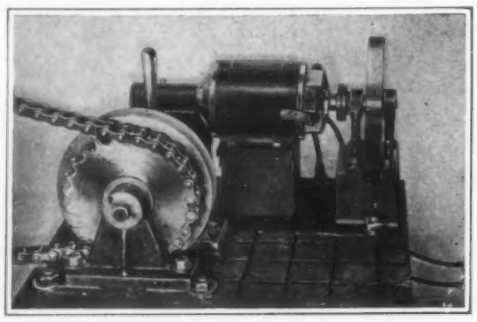
The relative size of the gas engine and the small electric starter is shown in the accompanying engraving. In the drawing may be seen details of the gearing. The motor is indicated at *A*, and the flywheel at *B*. On the motor shaft is a worm *C*, engaging with a wormwheel *D*. The wormwheel is clamped by the spring *E*, between friction plates *F*, keyed to a shaft. The shaft is connected by a clutch with a second shaft. The clutch members are shown at *G*, and they may be thrown into or out of mesh by means of the lever shown. The pinion *H* on the second shaft communicates its motion through the medium of two idlers *I* to the internal gear *J*, and thereby to the sprocket wheel *K*. There is a 25 to 1 speed reduction between the worm and the wormwheel and a 5 to 1 speed reduction between the pinion *H* and the internal gear *J*, while between the sprocket pinion *K* and the sprocket on the crankshaft of the gas engine, there is a further 2 to 1 reduction, making in all 250 to 1 between the motor and the engine. The sprocket wheel on the engine is connected by a ball clutch with the engine shaft, so that once the engine is started it can run free. To prevent a back kick of the gas engine from hurting the mechanism of the starter, the friction mounting of the wormwheel *D* is used instead of keying the wormwheel directly to the shaft. Thus with one third horse-power for ten seconds the same work is accomplished as required by the old method 1½ horse-power for an hour and a quarter.

Naturally this success led to experiments with an automobile starter built on the same principle, and a 1/3 horse-power motor was evolved only five inches in diameter and eight inches long, and weighing about 24 pounds. This is one of the speediest motors ever constructed for low-voltage service. It is designed to run on 12 volts and attains a speed of 17,000 revolutions per minute without the flywheel. With the flywheel the speed drops down to 13,000 revolutions per minute. The flywheel is 6 inches in diameter and weighs five pounds, and when running at 13,000 revolutions per minute it has a stored energy of 9,000 foot pounds. This is equivalent to 16 horse-power for one second, and it will even run up to fifty or sixty horse-power if the motor is congealed.

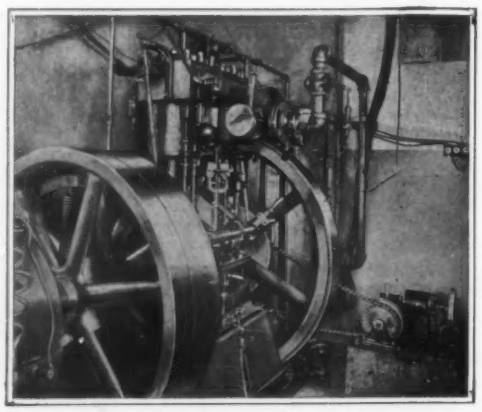
This starter may be used in connection with a lighting system. To drive this motor and to light the car as well, a six-cell battery of 12 volts and 25 ampere hours capacity is furnished. The battery is about half the size and weight of any required for the same service heretofore. The motor is charged by a generator about four inches in diameter and seven inches long, which, when the car is running ten miles an hour, is driven at a constant speed of 1,500 revolutions per minute. It absorbs one sixth horse-power and generates 225 watts or 15 amperes at 15 volts; the gearing between the starter and the engine shaft gives a speed reduction of 68 to 1. There is so much surplus power in the flywheel that in actual test a 92 horse-power engine was cranked six times on the magneto after the electric current had been switched off.



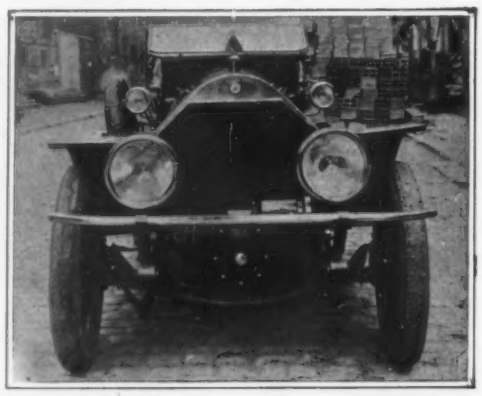
The gearing of the gas engine starter.



Gas engine starter, consisting of a 1/3 horse-power motor with flywheel and 250-1 gearing.



The gas engine and the baby starter.



The electric starter attached to an automobile in front of the radiator.

This starting device may be mounted directly upon the engine or between the flywheel and the gear box or upon the gear box with its gearing inside the box; but in order to make it available for all classes of cars a special design of starter operating on the same principle has been arranged to be attached to the front of any car, operating directly on the crank-shaft. One of our photographs shows a starter of this sort attached to a 90 horse-power car. There is a ball clutch connection between the starter and the crank-shaft, and so, if for any reason the starter should fail to work, the operator of the car would have no difficulty in cranking his engine by hand.

Another development of the gas engine starter is an electric brake in which the energy stored up in the flywheel is utilized to produce a powerful braking action in an emergency. Again the baby motor of one third horse-power will be able to wind up the brake chains and bring a heavy street car to an abrupt stop, as demonstrated by experiments in the inventor's shops.

The Annual Report of the Commissioner of Patents

THE annual report of the Commissioner of Patents, for the fiscal year ending June 30th, 1912, has just been submitted, and in it are many things which will be found illuminating. This report is made to the Secretary of the Interior, the annual report to Congress being made on the first of January of each year. The Commissioner is one of the very few officials of the Government who are required by law to make two annual reports.

A brief *résumé* of the statistical portion of the report shows that during the fiscal year ended June 30th, 1912, there were received 69,236 applications for mechanical patents, 11,775 applications for designs, 195 applications for reissues, 7,238 applications for trade-marks, 941 applications for labels, and 362 applications for prints. There were 35,539 patents granted, including reissues and designs, and 4,635 trade-marks, 625 labels, and 268 prints were registered. The number of patents that expired was 19,634. The number of allowed applications which were by operation of law forfeited for non-payment of final fees was 6,970. The total receipts of the Office were $2,094,059.50; the total expenditures were $2,025,912.30, and the net surplus of receipts over expenditures was $68,147.20. The grand total of net surplus receipts over all expenditures is now $7,132,072.96.

These statistics show a material increase during the last fiscal year over the year ending June 30th, 1911. The total number of applications for patents for inventions, for designs, for reissue of patents, registration of trade-marks, registration of labels and registration of prints, disclaimers to patents, and appeals on the merits, is 81,459. The total of all applications for the fiscal year immediately previous was 76,383 for the same period, which shows an increase of 5,076 applications received. The number of applications for mechanical patents shows an increase of 4,082 over the previous fiscal year of 6.26 per cent and an increase for the ten years since 1903 of 40.72 per cent.

Recommendations Regarding the Working Force.

Commissioner Moore has done more for the employees of the Patent Office than any of his predecessors. He succeeded in persuading Congress to increase the salaries of the examining corps, so as to make employment in that office sufficiently desirable for the retention of the high-class men, who are absolutely necessary if the best work on applications is to be expected. In his present report he states that there is still further necessity for recognizing the high grade of work required of the examining corps. He points out the fact that the Office is self-supporting, and maintains that fact as a reason for excepting the Patent Office from the general plan of economizing in Government salaries rigidly pursued by Congress. He also states that the trained examiners are in constant demand with prominent firms of attorneys and business companies, and it is the rule, rather than the exception, that when a man is sufficiently experienced and trained to become of value to the Patent Office, he receives an offer of higher compensation from the outside. This exodus of a trained class of men necessarily has a tendency to reduce the average efficiency of the corps, so that it is a difficult task to maintain a proper standard for the expeditious and successful conduct of the public business. This is declared by Mr. Moore to be not only demoralizing to the Office, but is also a handicap to the commercial interests of the country, which are entitled to the best

possible service from the Patent Office. He therefore renews his appeal for larger salaries for the examining corps.

Collective Trade-marks.

Among the subjects treated in Mr. Moore's very able report, is the matter pertaining to collective trade-marks. The International Convention for the Protection of Industrial Property, signed at Washington, June 2nd, 1911, which becomes effective in ratifying countries April 1st, 1913, contains a provision at Article 7½ for the filing and protection of trade-marks belonging to associations, the existence of which is not contrary to the law of the country of origin. The need for legislation on these lines was set forth in the President's message to Congress of February 2nd, 1912, and a bill was prepared at that time by the Commissioner of Patents, the passage of which would cause the laws to conform with the above-mentioned provision of the International Convention of 1911. Laws for the enforcement of collective marks are in force in European countries, and the draft of the bill which was submitted to the President, conforms substantially in terms to the provisions of law upon this subject, found in the British Trade-mark Act of 1905.

Gains in Efficiency and Economy.

Following the prescribed policy of Departmental administration at Washington, the Patent Office has given attention to matters of internal economy and increased efficiency, and the Commissioner points to the abolition of the so-called library edition of the *Official Gazette* as having accomplished a saving to the Office of about $65,000 annually.

The rebinding and classification of works in the valuable Scientific Library is a necessity which confronts the Office at all times, and an appropriation is needed for carrying this work on more extensively. A revision of the index of periodicals is sought to be undertaken, and the present condition of the index is referred to as unsatisfactory. The Scientific Library appropriation is inadequate to its growing needs. A great saving of time, however, has been effected by bringing to the library a triplicate set of French patents and arranging them in order of the French patent classification, which is an excellent numerical arrangement for searches. These French triplicates were formerly stored in the galleries. It is proposed that the German triplicate copies be brought to the library for classification and convenient use. In order to complete the set of German patents, 50,000 of which are missing, being the first of the issue, about $15,000 will be required. This classification will save time, labor and wear and tear of expensively bound volumes. All searchers agree that the classified columns are much preferable to those arranged numerically or chronologically.

Independent Bureau Desirable.

To separate the Patent Office entirely from the jurisdiction of the Department of the Interior, and make it a separate and independent Bureau is a project to which Mr. Moore refers and which he heartily endorses. While this feature is presented in his current report for the first time, it has been a matter which has claimed the attention of past administrations. At one time it was contemplated in connection with the establishment of the Department of Commerce and Labor, but the project was not carried out, due largely to lack of adequate housing for the newest Government Department. Mr. Moore, however, is in favor of the independent bureau idea and states that this would not only place the Office upon a more stable footing with regard to the exercise of its executive and judicial functions, but would relieve the Interior Department of the physical burden of caring for and appropriating for the Bureau. He states that this would be a step in the direction of progress, and that it would also be in the interest of efficiency and economy. Its duties as an Office are purely judicial in character, with such incidental clerical work as is necessary to carry them out; it requires in its employees special training along scientific and legal lines, and such employees are difficult to obtain and to retain in service, except at salaries higher than those paid to the other employees of the Department. The Patent Office has nothing in common with the other bureaus of the Interior Department, or of any other Department. There is no appeal to the Secretary of the Interior in question relating to the granting of patents, and all appointments to positions in the Patent Office, are made upon the nomination of the Commissioner. The desirability of this change in the status of the Patent Office is recognized and provided for in a bill introduced by Mr. Oldfield, chairman of the House Committee on Patents, on April 16th, 1912, and known as H. R. 23,417.

The subject was also ably discussed by the late Senator O. H. Platt, of Connecticut, one of the best posted men on the character of the work of the Patent Office and its needs who ever sat in either House of Congress, in a speech delivered in the Senate on March 31st, 1884, and from which the Commissioner, in his report, quotes the following extracts:

"I say that the Patent Office should be made an independent department, not only because of the vast importance of the interests which it must care for, but because of the treatment which it has received and must continue to receive as long as it remains a subordinate branch of the Interior Department.

. . . .

"What should be the qualification of the head of the Patent Office? He should combine an accurate and almost universal knowledge of mechanical principles with a thorough knowledge of patent law and with rare executive and administrative ability. He should be prominently distinguished for these qualities. His position should be one of entire independence. It is more judicial than executive. His duties are more like those of a judge of a court than an executive officer; they are purely judicial and ministerial. The Office should be permanent, and it should be nonpolitical, by which I mean it should have no political significance.

. . . .

"Every year's experience adds greatly to the capacity and ability of the Commissioner of Patents. In a word, the Patent Office needs and demands better administration, and it never will have it as a rule until it shall be made a separate department. It must be held in entirely different estimation by Congress and by public sentiment before it will be what it ought to be. The way to secure this estimation by Congress, the way to secure for it what it wants and what it needs and what it must have if it is properly to discharge the high functions which devolve upon it, is to separate it entirely from any supervision by the Secretary of the Interior, to make it independent and dignified."

New Patent Office Building.

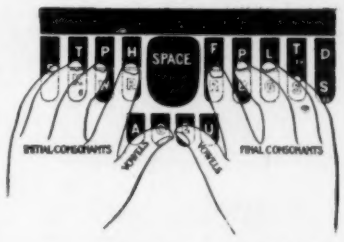
The subject of the present vital needs of the Patent Office is again brought up and vigorously expounded by Commissioner Moore. In all of his reports during the past several years, he has pointed out the unhappy conditions that now exist, and expressed the hope that Congress would do something to relieve the situation. The disgraceful physical conditions in the Patent Office have been widely published, and commented upon, and the erection of a new and modern equipped building is a matter which has been close to Mr. Moore's heart ever since he became Commissioner in 1907. He has worked for it unceasingly, and in view of the fact that the President's Commission on Economy and Efficiency, which investigated the Patent Office this fall by direction of the President, under the provisions of House Joint Resolution No. 337, has taken the matter up and Mr. Moore seems to be on the eve of having this great public need realized. It was owing to this investigation of the Patent Office and the subsequent report of the Commission on Economy and Efficiency, which is not yet ready for distribution, that Mr. Moore refrained from elaborating his previous recommendations in this regard.

The report, however, while brief, is comprehensive and shows evidences of the watchful care which the Commissioner exercises over the Patent Office. No man who has ever occupied the office of Commissioner has done so much for the Patent Office as Mr. Moore, or put as much whole-hearted effort into modernizing the Bureau, both on behalf of the employees and the Government, and the public—inventors, merchants and manufacturers—as well.

A Machine That Writes Shorthand

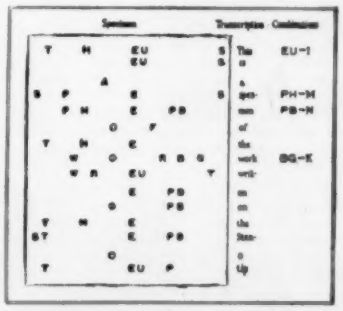
THE attention of the stenographer, and his or her employer, has recently been attracted to a new office device, designed to take the place of the pencil and notebook in taking dictation. The "stenotype" is a little eight-pound machine constructed along the lines of the typewriter, but so designed as to admit of the striking of the keys on the keyboard in multiples instead of one at a time.

The writing is in plain type letters on a strip of paper similar to that used on adding machines, the paper being automatically fed with each stroke of the keyboard, from a roll carried inside the machine. Printing is effected through a ribbon, which is automatically operated, as in the modern typewriter.



The keyboard of the machine.

The interesting feature of this machine is the system whereby with a keyboard of twenty-two keys, the English language can be written on an average of a word at a stroke. As will be seen from the illustration, the keys are arranged in pairs, so that each finger has a pair of keys to operate. Instead of printing at a common printing point, the type are located in a straight row, side by side, close to and in front of the platem (the travel of the type being only one sixteenth of an inch the operation of the machine is noiseless). If all the keys on the keyboard were struck at one time, a row of characters would be printed across the strip of paper as follows:



Specimen of the record.

STKPWHRAO*EUFRPB
LGTSDS

To write a certain word, therefore, the letters necessary to print that word are selected from the keyboard and struck. The word *starts* would be written by selecting the letters

ST A R TS

and would appear as here shown across the strip of paper. If the reverse of this should be written, it would then appear as follows:

ST RA TS

By observing the sequence of letters as they occur on the keyboard and correspondingly on the type at the printing point, it will be seen how these words may be written. The keyboard is divided into three groups; the initial consonants writing at the beginning of the line, the vowels in the middle, and the final consonants at the end. In the words above written, the initial consonants were written with the fingers of the left hand, the vowels with the two thumbs, and the final consonants with the fingers of the right hand. All the initial consonants, vowels and final consonants do not appear on the face of the keyboard. The missing letters are obtained by the use of arbitrary combinations of letters on the keyboard that do not occur in a sequence such as is found in any word in the language. To illustrate: the combination of "TK" among the initial consonants represents the initial "D" in words. "Darts" and "Dreads" would be written as follows:

TK	A	R	TS
TK	R	E	DS

All figures, marks of punctuation, proper names and foreign words and phrases may be written with absolute accuracy.

Considering the speed at which the keyboard of a typewriter is struck and the fact that on the shorthand machine a word at a stroke is obtainable, it is apparent that a rate of speed much higher than that of the average stenographer is easily obtained. Because the fingers have so few keys to manipulate, a great degree of accuracy is assured. The fact that plain type letters are written, not subject to misinterpretation because of poor penmanship, and the fallibility of hand-made shorthand notes, insures an absolute legibility. As a matter of fact, any person familiar with the system of characters, can read the notes of any operator.

As the paper upon which the writing is done leaves the machine, it is automatically rewound on a spool on a little rewinding device attached to the rear of the machine. This spool is transferred to a copy-holder, which reverses the paper so that the first notes written are on the outside and feeds the paper forward as the transcription is being made on the typewriter.

Notes for Inventors

An Improved Match.—John R. Nolan of New York City, assignor to the Diamond Match Company, has secured patent, No. 1,042,464, for a match whose stick is provided with a substantially continuous series of adjacent peripheral grooves so formed as to present a multiplicity of thin burning edges which extend lengthwise of the stick with the igniting head of the match firmly embedded in one end of the grooves.

Novel Binding Material for a Road Surface.—Among the many patents granted Carleton Ellis of Montclair, New Jersey, is the patent, No. 1,042,538, assigned to the Ellis-Foster Company, of New Jersey, for a process of making concentrated sulphite liquor adapted for use as a binding material in the treatment of road surfaces wherein approximately neutralizing waste sulphite liquor fermenting said liquor and concentrating it to a heavy bodied syrupy condition, is carried out in producing a liquor suitable for the purpose.

Wanted An Automobile Lock for the Starting Crank.—Now and then we read of a man who has been run over by his own automobile while cranking it, merely because he forgot to put the lever in neutral. One of the readers of the SCIENTIFIC AMERICAN suggests that those who are mechanically inclined should endeavor to invent an attachment that would connect the crank with the lever in such a way that the automobile can only be cranked when the lever is in neutral. This could also be done with a self-starting device.

Condition of Patent Office Work.—At the close of business November 23rd the total number of applications for patent awaiting the action of the United States Patent Office was twenty-six thousand and eighty-three. The total number of cases pending in the Patent Office must also include the pending applications which have been acted on by the Patent Office and are awaiting amendment or other response on the part of the applicant. By reason of an actual count made during the past summer of the pending applications, it is fair to assume that there are at present from one hundred and twenty-five to one hundred and fifty thousand applications for patent actually pending in the Patent Office at the present time.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

SAFETY ATTACHMENT.—W. P. ALDEN, 25 Burnside St., Portland, Ore. This is an inexpensive device adapted for safeguarding a watch by attaching it to the clothing, wherein a support is provided for the watch, which will permit the watch to be taken from the pocket for inspection and returned without releasing the watch from the fastener, or the fastener from the clothing.

GARMENT SLEEVE.—A. GOLDBERG, 134 W. 26th St., Manhattan, New York, N. Y. The invention refers to sleeves of garments such as shirts, shirtwaists and the like, and has reference more particularly to a garment sleeve having a cuff portion adapted to be held in different positions, and a part normally concealed by the cuff portion and constituting means for holding the cuff portion in a raised position.

Of Interest to Farmers.

SEED PLANTER.—C. KNOPF, care of H. A. Turner, R. F. D. No. 1, Winona, Minn. An object of this invention is to provide an implement which will be so efficient in action as to drop the seeds in sufficient number and at such distances apart as to avoid the waste of seed and labor in subsequently chopping out the superfluous plants.

DEVICE TO PREVENT DOGS FROM WORRYING SHEEP.—W. GRAHAM, Cookshire, Quebec, Canada. The object here is to provide a device which may be fastened to the nose of a dog, and which is provided with hooks which will become entangled in the wool of a sheep so that when the sheep starts to run the dog's nose will be pulled, and the latter receive a lesson which will break him of his sheep worrying habit.

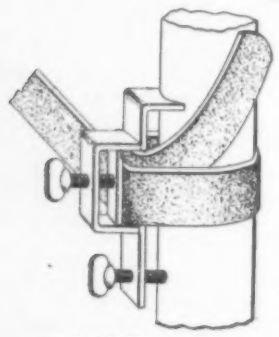
Of General Interest.

HORSESHOE CALK.—W. GORDON, 1743 N. 8th St., Philadelphia, Pa. The object here is to provide a construction which will be easily applied to and removed from the horse's hoof at will, when in place, be securely held against displacement in any direction and will embody means which will aid in the adjustment of the attachment to hoofs of different sizes.

Hardware and Tools.

COMBINED PIPE VISE AND PIPE CUTTER.—C. BRACK, 1721 Harford Ave., Baltimore, Md. This tool is for clamping and holding metal pipe while being screw-threaded and also for cutting such pipes in different lengths. The body of the tool may be temporarily clamped upon a bench, table, shelf, or other support, and a detachable, reversible lever is pivoted to such body and adapted for use both in pipe-threading and cutting, according to the position in which it is placed.

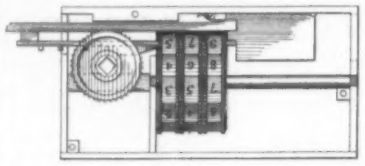
FASTENING DEVICE.—R. V. SAMPSON and S. T. DANLEY, 1643 Champa St., Room 17, Denver, Colo. This invention relates generally to fastening devices and more particularly is directed to a structure which is especially



FASTENING DEVICE.

adapted for securing the lines from the bridle bit or halter of a horse in order that the animal may be hitched to a post or other support. It provides a device especially adapted for this use which may co-operate with any hitching post or pole, it being adapted to efficiently perform its purpose and at the same time being inexpensive in its make-up. It may be easily carried on the person and adapted for use with any hitching post in order to secure the reins or lines extending from the bridle bit or halter in order that the animal may be hitched. A perspective view of the device in operative position is shown in the engraving.

COMBINATION MANET LOCK.—N. S. G. RESHAROV, 308 Sussex St., Paterson, N. J. In this simplified form of lock the combination to permit the actuation of the bolt may readily be changed from the outside of the lock. In this invention it is possible to draw the bolt only when the tumblers are in the position in which they were set when the bolt was thrown. A number of wheel-shaped tumblers are provided, having gates in their peripheries, which gates are adapted to be opened to permit the throwing of the bolt, which gates are locked in their open position after the passage of the bolt, it being possible to retract the bolt only when opened gates are in alinement. Retracting the bolt releases the means holding the gates in open position, thereby

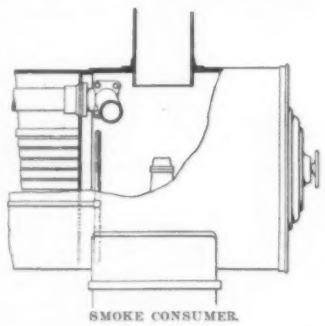


COMBINATION MANET LOCK.

closing all of the gates in position to be uncovered when the bolt is again ejected. The illustration shows a side elevation of the lock with the front casing removed to show the internal mechanism with the bolt in retracted position.

Heating and Lighting.

SMOKE CONSUMER.—H. B. KERRUISH, care of R. H. Sherry, 2334 Tower Grove Ave., Sullivan, Mo. In this patent the invention relates to smoke consumers, and it has for its object to provide a flue boiler with pipes with openings at the front of the boiler, through which air may be carried to mix with the heated gases coming from the flues at the front of the boiler to complete the combustion.



SMOKE CONSUMER.

Various applications of the invention may be used, since the invention includes all constructions in which air is admitted between the fire chamber and the smoke-stack, whether flue boilers are used and whether the boilers are stationary or of other types. The engraving represents a sectional view, showing the front of the boiler, supplied with the smoke consumer.

Household Utilities.

TRANSOM LIFT.—G. W. MCCARTY and D. F. HARNESS, care of D. F. Harness & Son, Oklahoma, Okla. The invention is an improvement in transom lifts, and the aim is to provide a simple, inexpensive, easily installed device by means of which the transom may be swung into any desirable position and so held and having automatically acting means for preventing accidental movement of the transom.

BURNER.—J. D. LANGSTON, 2502 5th Ave., Birmingham, Ala. This burner is for use in cook stoves, ranges or heaters, adapted to utilize oil for fuel. The device is provided with means for gasifying the oil and burning the gas which may be applied to existing stoves, ranges or heaters, with slight changes to the stoves, ranges or heaters.

JAR COVER STRAIGHTENER.—B. S. KNUTSON, Steward, Ill. In the present patent the invention has reference to household devices, and particularly to means whereby common metal fruit jar tops may be straightened after being distorted, and used repeatedly, instead of discarding them unnecessarily.

Machines and Mechanical Devices.

HYDRAULIC JACK.—F. LYNT, 233 W. 54th St., New York, N. Y. The invention provides a jack for use on heavy trucks and the like and arranged to permit of conveniently raising the part without requiring much physical exertion on the part of the operator, to allow quick lowering, and to retain the liquid for re-use without danger of leakage.

METAL ROLLING MACHINE.—J. K. HAUBERG, care of J. S. Moothard, Cando, N. D. The distinguishing feature here is a roller carried by a reciprocating frame and adapted to act on a heated metal plate while held on an anvil block, and mechanism for adjusting such block higher or lower, or at different angles, according to the bevel it is desired to impart to the plate.

YARN CONDENSER AND POLISHER FOR CORDAGE SPINNING MACHINES.—O. NEDVIDEK, R. F. D. No. 2, Milwaukee, Ore. This invention is an improvement in so-called "nippers" or machines designed for treating, that is to say, condensing and rounding and polishing hemp, yarn or slivers preliminary to spinning for making ropes and cordage.

PULLEY BRAKE FOR MOTOR CONTROLLED APPARATUS.—M. TAIGMAN, 241 Wooster St., New York, N. Y. This inventor provides a readily actuated brake mechanism for simultaneously manipulating the brake to apply the same when the power is shut off, said mechanism having means for adjusting the support of the brake whereby the wear in the latter may be taken up and the effectiveness of the brake action varied.

Prime Movers and Their Accessories.

ROTARY ENGINE.—C. B. ZAHN, care of A. E. May, 106 Wilder Bldg., Rochester, N. Y. This invention provides a simple form of connecting mechanism between the pistons whereby the intermittent and step-by-step partial rotary movements thereof shall be automatically controlled and whereby the intermittent rotations of the pistons through the inter-connecting controlling mechanism will result in imparting to a driven shaft a continuous rotary movement.

STEAM HYDRAULIC INTENSIFIER.—T. E. HOLMES, 8 Oakdale road, Nether Edge, Sheffield, England. This invention provides valve-controlled connections whereby the steam may, on the completion of its primary function, be admitted to and allowed to act expansively in the steam cylinder of the intensifier, so as to correspondingly reduce the quantity of steam required in this cylinder.

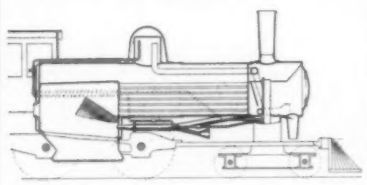
PACKING.—G. E. WRIEDT, deceased, care of W. A. Kruger, 16 Newberry St., Providence, R. I. Use is here made of a tubular packing made in sections and encircling the rod or stem, the sections being provided with conical ends, the rings having conical openings engaging the said conical ends for holding the sections together and pressing the same against the rod or stem.

Railways and Their Accessories.

APPLIANCE FOR CONTROLLING MOVING TRAINS.—J. F. KIMBER, Apple Creek, Ohio. By means of this device a letter, telegram, or order may be held in position to be caught by a trainman on a moving train, wherein the inclosure may be so held that there will be no possibility of failure on the part of the trainman to locate the inclosure by day or by night, and will release the inclosure as soon as traction is made thereon.

METALLIC RAILWAY TIE AND RAIL FASTENING THEREFOR.—M. J. SHANNON, care of A. G. Kerns, Wallace, Idaho. This invention is an improvement in metallic ties and devices adapted to support rails thereon and to secure the supports and rails themselves thereto. Means provide for the introduction of a wedge to raise a block becoming lowered by wear; also to compensate for compression and wear of the cushion plate. The latter may be made of paper and will deaden sound and prolong the life of the rails.

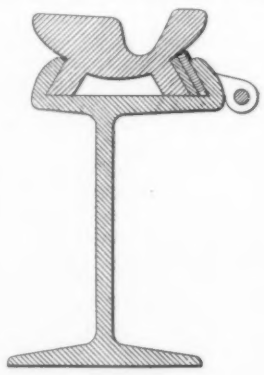
SMOKE CONSUMING APPARATUS.—H. N. MARTIN, Chichester and Morris Aves., Morris Park, L. I., N. Y. This apparatus is designed to be applied preferably to locomotives and traction engines in general, and the



SMOKE CONSUMING APPARATUS.

purpose thereof is to devise means for taking a part of the smoke before the same is discharged from the stack, and mixing it with air, to be returned into the firebox, whereby all the particles of carbon and other inflammable substances suspended in the smoke and other gases, can be completely consumed before the smoke is discharged through the stack into the surrounding atmosphere. In the engraving a longitudinal sectional view of a locomotive is shown to which the smoke consuming apparatus is applied.

RAIL.—H. COLLINS, 69 East 87th St., Manhattan, New York, N. Y. The invention relates more particularly to rails such as are used in streets and flanked by the pavement with



RAILROAD RAIL.

only the heads visible. The invention provides a rail arranged to permit convenient removal of a worn out rail head and replacing the same by a new one without disturbing the position of the remainder of the rail on the ties and without requiring tearing up all of the pavement flanking the rail, thus saving considerable expense on rails and time and labor in replacing worn out heads by new ones. For this purpose use is made of a rail head seat, a removable rail head seated on said seat, and wedges for wedging the rail head in place on the seat. The engraving shows a transverse section of the rail.

BLOCK SIGNAL SYSTEM.—W. A. LACKE, 8010 Constance Ave., Chicago, Ill. By the use of this electrically-operated mechanism a semaphore arm, or analogous member, may be caused to assume a number of separate positions under the automatic control of the rolling stock; and after the signalling members is once set in any of its positions by aid of an electric current, no further current is used in holding it in such positions.

RAILROAD TIE AND RAIL FASTENER.—F. C. SEAMAN, 3 Academy Place, Oneonta, N. Y. The intention here is to provide certain new and useful improvements in railroad ties and rail fasteners whereby the ties are rendered practically indestructible and the rails are securely held in place to prevent the same from spreading.

EXTENSION DEVICE FOR CAR PLATFORMS.—K. L. ELSNER, 882 Union St., Brooklyn, N. Y. The object in this case is to attach to the ends of the car adjacent the doorway a device which can be connected to move in unison with the door to bridge the space between the car and the platform as soon as the door is opened and thus eliminate all risk of accident and injury.

Pertaining to Vehicles.

HEADLIGHT.—E. L. WICKETT, care of L. D. Kirkpatrick, 7 and 8 Mercer Bldg., Aledo, Ill. In this case it is sought to provide the light on the frame of the car in such manner as to permit the adjustment of the light to cast its rays either straight forward or at any desired angle either to the right or to the left, whether the car is moving or still.

TIRE INFLATER.—W. A. VINSON, R. 5 No. 44 Vancouver, Wash. An object of this inventor is to provide a simple and efficient tire inflater adapted to be operated by the motor of an automobile or the like, and serving automatically to maintain the pneumatic tires of the vehicle inflated at a predetermined pressure.

MOTOR VEHICLE DRIVING GEAR.—J. A. SCHARF, Richwood, Ohio. This invention provides a mechanism employing a plurality of driving friction disks and plurality of movable transmission wheels operatively engaged therewith, means for shifting the wheels to engage and disengage the disks in planes perpendicular to the disks whereby extreme width of the friction surface of the wheels is made effective; provides mechanism for shifting the disks by varying the speed of transmission and for discontinuing the same; and provides for varying the speed of transmission mechanism on opposite sides of the vehicle to produce an effect similar to that obtained when employing a differential mechanism while following a curved path.

SANDING DEVICE FOR AUTOMOBILES. L. W. SAMUELS, 535 W. 113th St., Manhattan, New York, N. Y. In this device for automobiles and similar vehicles a hollow mud-guard is utilized as a sand receptacle and is provided with means for controlling the discharge of sand upon the periphery of the wheels for the purpose of preventing skidding.

Designs.

DESIGN FOR A PENHOLDER OR SIMILAR ARTICLE.—M. BERNSTEIN, 3607 Broadway, New York, N. Y. In this design for a penholder, the handle is gourd shaped in beautiful lines and ornamentally scrolled at the larger end. A chain hangs from the article, and at the small end of the latter a pen is inserted.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 9288. Wanted the names and addresses of concerns that can coat steel balls with pure tin one-sixteenth of an inch thick.

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Inquiry No. 9290. Wanted name and address of a manufacturer of a patented device which is suitable for making up pay envelopes, namely, to fold up bills and insert them with minor coins in a pay envelope of the usual size.

Inquiry No. 9291. Want to buy machinery for manufacturing wooden tooth picks.

Inquiry No. 9292. Wanted a gum that will stick labels to grape-fruit;

Inquiry No. 9293. Wanted the names and addresses of manufacturers of waterproof cloth, also samples of such cloth.

Inquiry No. 9294. Wanted to buy glass balls 1¼ x 1¼" in diameter.

A Parcels Post Tunnel Railway

(Concluded from page 4.)

gears to an electric motor mounted on the front end of the car. At the rear end there is a small trolley pole with a T-shaped head, which bears upward against the under side of the conductor rail. A reversing switch for changing the direction of motion of the car is located close to the trolley. A direct current of 230 volts is used in the propulsion of the car, the current going out through the conductor rail and returning by the central track rail. In order to isolate the electric circuit and to give a direct current of desired voltage, the power is supplied by a motor generator. The small car can be driven at almost any reasonable speed, since there is no tendency to leave the track in turning sharp curves; but it is believed that in service a speed of 20 miles per hour will be found most practicable. If an ordinary two-rail track were employed instead of the three-rail construction described, it would be impossible to give sufficient super-elevation of the outer rail on the curves of so short a radius to keep the car on the track at maximum speed; but with the three rails the outward thrust due to centrifugal force is taken by the outer guide rail, and there is no component tending to derail the car. Cars can be dispatched singly or coupled in trains.

In the station the conductor rail is placed at the side of the track, and is connected to the generator through a resistance which gives the car a low velocity. To move the car in the station the operator pulls a hand lever that throws a contactor out against this side rail, but on releasing the lever the contactor is drawn away from the rail by a spring, so that the car continues its movement only so long as the operator holds the contactor on the rail. This makes it possible to easily move the car about in the station. The car is dispatched by running it into the tunnel far enough for the trolley to make contact with the overhead conductor rail, then it is propelled automatically along the line until it arrives at the station, where the trolley leaves the conductor rail, cutting off the supply of current to the motor. The car is brought to rest by sliding on wooden skids which are laid on each side of the center rail. Underneath the car are two wooden-faced shoes, which are made to bear upon the skids by a slight depression in the center rail. This is similar to the method employed in stopping the cars of "roller coasters" seen at amusement parks, but differs somewhat in detail. The car slides along the skids for a distance of 30 or 40 feet, coming gradually to rest without shock. As soon as it stops, by lifting a handle the shoes are unlocked and allowed to swing upward, which permits the car to rest on the track again, and then it can be moved forward out of the way of the following car. Cars can be run at intervals of half a minute, and they are prevented from overtaking one another by the use of constant speed motors. As the speed of each car is practically the same throughout its travel, regardless of curves or grades, a nearly constant distance is maintained between them. Experiments show that in descending the 5 per cent grade which leads into the station at the demonstration plant, the motor on the car becomes a generator and returns power to the line. This has the effect of a brake on the car and prevents excessive speed on down grades. In ascending the 5 per cent grade, no appreciable diminution in speed is noticed.

Where several stations are located along a line, automatic switching devices can be provided whereby cars can be made to stop at any predetermined station. Such switching devices are not shown at the demonstration plant.

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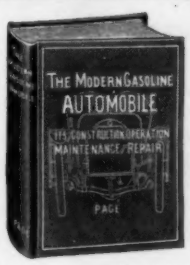

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of the car pass over them are located at intervals of 20 feet along the track, thus recording the time of passage of the car over each 20-foot section of track. Half second intervals are also recorded on the chronograph by connection through the pendulum of a clock. The power consumed by the motor on the car is registered by a recording wattmeter, the chart of which makes one revolution while the car makes the circuit of the track. An electrically controlled pen in the time circuit of the chronograph records half second intervals on the edge of the chart. Thus the records of the chronograph and the wattmeter are co-ordinated. Air resistances in the tunnel are measured by a photographic recording water column.

Progress of the Weather Bureau

THE annual report of the Chief of the Weather Bureau, just published, covering the fiscal year ended June 30th, 1912, while containing nothing of sensational interest, is a record of substantial progress in the meteorological work of the Government. The following items are especially worthy of notice:

As usual, the work of the Mount Weather Observatory heads the report. The scope of this institution has been somewhat enlarged, as it now serves as a school of instruction for newly-appointed observers, who spend a few months here before being assigned to stations in the field. For five years past the observatory has been making daily observations of the upper air, with kites and captive balloons, in all kinds of weather. The results of these observations, telegraphed to Washington, are sometimes highly useful to the forecaster, at other times less so; hence the plan of making daily flights has been discontinued, and hereafter flights will be made only when there is a type of weather above the station that it is desired to explore. During the year three series of continuous kite flights were made for periods of 24 hours each, in order to obtain information concerning the diurnal variation of temperature at various altitudes in the free air. The Bureau has published a valuable digest of all the sounding-balloon observations heretofore made in this country, viz., 79 made by the Mount Weather staff at certain places in the West, and 59 made by the staff of the Blue Hill Observatory. Studies on the relation between the temperature on mountain tops and that of adjacent valleys have been continued. These have a practical bearing on the question of air drainage and its effects on fruit in the valleys.

Perhaps the greatest desideratum in meteorology is more knowledge concerning radiation from sun, sky and earth, and the Weather Bureau is doing its part toward supplying this need. The radiation received from sun and sky upon a horizontal surface is measured at Mount Weather by means of a horizontally exposed Callendar pyrheliometer. Direct solar radiation is measured with the pyrheliometers of Marvin, Angström, Callendar, and Abbot, and polarization of skylight is observed with the Pickering polarimeter and the Savart polariscope. The observations of polarization are employed in the study of atmospheric transmissibility, which not only varies with the weather from day to day, but also from year to year on account of causes not yet understood. All this is in line with the world-wide efforts that are being made to find out how much energy we receive from the sun, how the amount varies, and how this energy is disposed of by the atmosphere and terrestrial objects. On the answer to these questions depends the explanation of the principal mechanical phenomena of the atmosphere.

The Weather Bureau is co-operating with the University of Pittsburgh in the study of the smoke problem, which of course has meteorological bearings. Several contributions to pure science have been made during the year by the physicist of the Bureau, Prof. W. J. Humphreys, the most noteworthy being his explanation of the double diurnal fluctuation of the barometer.

The dream of the weather forecaster is to have at his disposal daily synchronous charts of the meteorological conditions over the whole world. Year by year the realization of this ideal is being approached. The chart of the northern hemisphere drawn every morning in Washington has recently been made more complete by the addition of reports from Dutch Harbor, in the Aleutian Islands; Nemuro, Japan; Shanghai, China; and several stations in Asiatic Russia. Now the great question is to bring the oceanic areas into the field by means of wireless reports from vessels, and the most important step in this direction has been achieved through the efforts of the Chief of the Weather Bureau, who as a delegate to the London Radiotelegraphic Conference last summer induced that body to agree to a regulation giving weather reports priority over all other wireless messages except distress calls. The Weather Bureau has already framed a tentative plan for a weather service covering the North Atlantic Ocean, and this will doubtless be put into effect as soon as European co-operation can be secured. In waters adjacent to the United States an effective wireless weather service is already in operation.

Other projects under way include an investigation of the mysterious "thermal belts" or "frostless zones" of the Blue Ridge Mountains; experiments with devices for frost protection, especially various coverings, which it is thought may be used not only for fruit trees, but also for vegetables and alfalfa; and, last but not least, a thorough experimental investigation of the errors of anemometers at high wind velocities.

The Respiration Calorimeter

ONE of the most efficient mechanical aids to the investigator of the changes which take place when a chemical substance or a plant or an animal is observed under controlled conditions is the respiration calorimeter of the Department of Agriculture.

The first report of experiments with the respiration calorimeter was published in 1897, during the first year of Secretary Wilson's administration. Since that time numerous bulletins and other papers have appeared which have described the apparatus, noted very important modifications and reported the results of investigations. As time has progressed, the apparatus as originally devised has been greatly simplified and made easier of operation, and so developed that more factors can be determined than was the case at first.

The respiration calorimeter was designed and has been used for the study of problems concerned with the food and nutrition of man and animal, the value of different foods as sources of energy for muscular work, and other similar questions. It has recently been adapted to the study of fruit-ripening and other problems of vegetable physiology, and is equally useful for the study of a great variety of other problems, as for instance, questions of ventilation of houses and farm buildings.

The experiments with the respiration calorimeter have furnished new facts and figures of great importance to students regarding the processes of respiration and accurate information regarding the energy which man needs to run his body machine and the effects upon his energy requirements of sleeping and waking, rest and work, and other factors. It is now possible to discuss such questions on the basis of accurate measurements, and this was not hitherto the case. The question of the energy which man expends to digest and assimilate his food has also been studied.

A deduction of great theoretical interest obtained with the respiration calorimeter experiments is that the law of conservation of energy holds in the animal body. Such a conclusion is at the basis of many important deductions regarding rations and diets and the use which man makes of his food and farm animals make of feeding stuffs.

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It is important to know its efficiency as compared with other machines. Experiments with the respiration calorimeter show this to be 20 per cent, that is, 5 units of energy must be supplied by the food to provide one unit of work. In this respect man compares favorably with the best steam engine, their efficiency, it is safe to say, not exceeding 14 per cent.

Whether or not physical energy must be expended for mental work as well as for muscular work is a question of interest. Judged by the results of a long series of experiments with the respiration calorimeter, severe mental work does not make demands for physical energy, at least in amounts that were measurable even with so accurate an instrument.

It is natural that an apparatus of this character should be used in the study of technical questions which cannot be approached by simpler means, and in part the results referred to above are technical. However, the usefulness of the respiration calorimeter is not limited to such matters, and it has been of great value in studying questions of everyday interest pertaining to food and the use which man makes of it. It is, in a large measure, due to this and related work that we are able to discuss such matters to-day with reasonable certainty.

The feeding standard is something which the farmer of to-day realizes is necessary for success, and a progressive farmer bases his practice on the feeding standards which experimenters have provided for him. If we are to make the right use of our available food supply, dietary standards are needed, and those proposed by the Department of Agriculture have had wide use. The proof of the accuracy, with respect to energy, of these dietary standards, has been obtained from experiments with the respiration calorimeter.

The discovery that the respiration calorimeter is equally as valuable for studying ripening-fruit processes and other problems of vegetable life and for the study of man's food and the way to use it, has opened up a new line of work. With the apparatus which has been built for this purpose and the larger respiration calorimeter for experiments with man, the Department is in a position to continue its investigations of technical and practical problems and to accumulate very useful and valuable information. The first stage in a valuable kind of work has long been passed, the apparatus and methods have been perfected, and facts of great value have been secured. New fields of usefulness are being entered upon, and the outlook for rapid accumulation of additional data of great importance to all who are interested in the profitable and proper use of agricultural products is assured.

How the Wind Carries Pebbles of Large Size

IT has been proved that a wind having a velocity of 23 meters per second is capable of transporting through the air particles of sand only when they do not exceed 2 millimeters in diameter. Yet occasional "rains of stones" of much larger size are occasionally observed. Thus, there is a record of the fall of stones in the Canton de Vaud having diameters ranging as high as 1½ centimeters and of weights up to 2.62 grammes. The nearest region whence they could have come was Maures and Esterel. The case is known also in Château Landon of small calcareous stones of 3 centimeters diameter being carried 150 kilometers.

In Sweden in 1883 stones as large as filberts, enveloped in large ovoid hailstones and weighing nearly 6 grammes, were carried 60 kilometers.

M. Thoulet discusses such cases in *Les Annales de l'Institut Océanographique* and suggests a plausible explanation. He thinks we must accept the idea of some sort of fixation around the pebbles of an envelope of air or vapor of water. The density of the body transported would cease to be that of the pebble, and become that of a mass of combined solid and fluid (or gaseous) matter, which would be sensibly lighter with respect to its volume.

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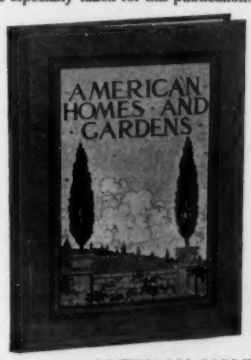

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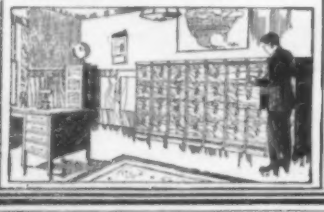

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NEW BOOKS, ETC.

CHEMICAL RESEARCH IN ITS BEARINGS ON NATIONAL WELFARE. London: Society for Promoting Christian Knowledge, 1912. Price, 50 cents.

The major portion of this little book is the lecture delivered by Prof. Fischer before the Kaiser Wilhelm Society. It gives a very interesting glimpse of the achievements in chemical research which have made Germany one of the most important manufacturing nations in the world.

LUFTSCHRAUBEN. Leitfaden fuer den Bau und die Behandlung von Propellern. Von Paul Bejeuhr. Mit über 90 Textabbildungen. Frankfurt a. M.: Verlag von Franz Benjamin Auffarth. 1912.

The author of this book assures us that it was written as a result of practical experience for practical men. It presents no new theories, but on the other hand, it discusses clearly and fully the prevalent views on propeller construction and action, with the object of so familiarizing the reader with the subject that when a new theory does come forth, he will be able to judge it critically. Starting with a few elementary principles, the author discusses the methods of such men as Wellner, Ferber, Eberhardt, Lanchester, etc. He explains how propellers are tested by various machines. He leads the reader by the hand through a propeller factory, and shows him how the best aeroplane and airship propellers of the day are constructed. The book concludes with a compilation of the most important formulæ.

BAU UND BETRIEB VON PRALL-LUFTSCHIFFEN. Von Richard Basenach, Ingenieur in Berlin. I. Teil. Frankfurt a. M.: Verlag von Franz Benjamin Auffarth, 1912.

It is the author's intention to discuss the subject of the dirigible airship in three parts. This is the first. As might be expected, it is devoted to a clear discussion of fundamental principles. The second and third parts, we are promised, will enter more in detail into the niceties of construction and operation. In this first part, the author has presented an account of the underlying principles of the dirigible airship, which must be read with lively interest not only by the layman but even by the professional builder of airships. It is not often that we find expert information delivered so lucidly and so instructively.

ADDRESSES TO ENGINEERING STUDENTS. Kansas City, Missouri: Waddell & Harrington, 1912. 8vo.; 563 pp. Price, $1.

Some time ago we made favorable mention of this collection of papers. Within three months of the issue of the first edition of three thousand copies, the supply was exhausted and a second edition made necessary. Its present form includes five additional papers of special importance, and as the work is not a money-making venture, but a true effort to place before engineering students and practicing engineers a series of papers by the greatest authorities, that shall prove a help and an inspiration, the success of the enterprise to date is encouraging, and its continued appeal is a foregone conclusion.

EFFECTS OF ERRORS IN SURVEYING. By Henry Briggs, M.Sc. Philadelphia: J. B. Lippincott Company, 1912. 12mo.; 179 pp.; illustrated.

The theory of errors, a branch of the theory of probabilities, owes its development to the labors of Gauss, while Bessel, following him, gave to the world valuable methods for distributing errors in triangulation and was also the first to apply these processes to trigonometrical surveys. There are a number of good text-books in existence dealing with the application of the "law of the least squares" to triangulation, but comparatively little progress has been made in investigation of the propagation of error in surveys. Hence the work in hand is a welcome contribution to the study of errors and their combination as they may affect the accuracy of surveys. Rules are formulated against the occurrence of such errors, and methods are devised whereby the mistake likely to occur in any given case may be properly accounted for, and taken care of. The criterion known as the "average error" has been adopted instead of that of the "probable error." In this the author is following sound precedent if not common usage, and he has at least easier computation on his side of the argument. Throughout, the treatment is frankly mathematical, and the reader's familiarity with the elementary branches of the subject is taken for granted.

THE GASOLINE AUTOMOBILE. A Practical Discussion of the Development and Present Status of the Automobile. By Victor Lougheed and Morris A. Hall. Chicago: American School of Correspondence, 1912. 8vo.; 307 pp.; illustrated. Price, $2.

CARE AND OPERATION OF AUTOMOBILES. A Handbook on Driving, Road Troubles and Home Repairs. By Morris A. Hall. Chicago: American School of Correspondence, 1912. 8vo.; 140 pp.; illustrated. Price, $1.

The two works are uniform in style and binding, and constitute a helpful contribution, albeit in an already somewhat crowded field. Disclaiming "The Gasoline Automobile" as in any way exhaustive, the publishers have designed it to meet a need for a reliable, readable presentation of the elements of the gasoline motor and its accessories, with a discussion of the newer features of the modern car. Illustration has not been spared, and the aims of the publishers have been adequately carried out by the authors. In the "Care and Operation of Automobiles," is presented as a separate volume the latter part of the first work. In other words, there is practically nothing in the "Care and Operation of Automobiles" that is not included in "The Gasoline Automobile." It simply allows those who want the practical suggestions on care and operation, and do not wish to study development and present status, to get these suggestions in separate binding. This should be distinctly understood. The information concerning private garages and repairs is timely and gives some very good pictures showing exterior appearance and interior arrangement. A list of the necessary tool equipment and its cost is given, with many home-made devices and conveniences, and clear instruction in the use of tools and the carrying on of repairs at home. By following these suggestions and directions, much of the expense of public garage repairing may be avoided, and the owner acquires a knowledge of his car and of repairs methods in general that cannot fail to be of the highest service to him on the road.

THE MODERN LOCOMOTIVE. By C. Edgar Allen. New York: G. P. Putnam's Sons, 1912. 16mo.; 174 pp.; illustrated. Price, 40 cents net.

As one of the Cambridge Manuals of Science and Literature, this little primer upholds the reputation of the series. Within its narrow confines is packed an astonishing amount of information regarding the design and working of the modern locomotive—the generation of its steam, combustion and vaporization, superheating, and traction effort. Frames and running gear, stability, performances and speeds—all are popularly but efficiently discussed, and glimpses are given into the wonderful methods and achievements of the locomotive shop.

RUBBER TRADE DIRECTORY OF THE WORLD, 1912. New York: The India Rubber Publishing Company. 8vo.; 313 pp. Price, $3.50.

This directory is issued under geographical divisions covering the United States and Canada, Central America, South America, Europe, Asia, Africa and Australia. These major divisions each include minor divisions which classify rubber goods factories, rubber planting companies, rubber and waste dealers, manufacturers of compounding ingredients, of rubber machinery, etc. In short, the directory has been vastly enlarged in scope since its first appearance in 1908. In the plantation list, it cites only those companies that are on an established basis. Yet we find listed no less than 132 rubber plantations with offices in the United States and Canada. Many influences have been at work during the past few years tending to unify the various branches of the rubber industry, and the factory end of the industry no longer lacks interest in the planting and cultivation of the product. The directory will doubtless be put to extensive use by manufacturers, importers, reclaimers, waste dealers, and planting companies.

FIRE PREVENTION. A Treatise and Textbook on Making Life and Property Safe Against Fire. By Peter Joseph McKeon. New York: The Chief Publishing Company, 1912. Price, $1.75.

An expert has here dealt with the reduction of fire prevention to a science, giving the reader a very full and complete set of instructions for the prevention and control of fires. He addresses himself to the owner and the occupant, and urges their co-operation with the department by making the buildings safe against fire; by removing dangerous material; by an adequate equipment of water pails, chemical extinguishers, standpipes, and automatic extinguishers; by automatic alarms and watchman service; by special signal calling the firemen direct to the building; by localizing the fire by means of brick-inclosed stairways and elevators; by seeing that stairs, elevators, and escapes are readily accessible; and by the establishment of the fire drill. The material is well arranged, the various safeguards clearly illustrated, and the arguments sound. The work may be recommended to business men, superintendents, janitors, householders, and the general public.

MOULDING CONCRETE FLOWER POTS, BOXES, JARDINERES, ETC. By A. A. Houghton, New York: The Norman W. Henley Publishing Company, 1912.

MOULDING CONCRETE FOUNTAINS AND LAWN ORNAMENTS. By A. A. Houghton. New York: The Norman W. Henley Publishing Company, 1912.

These two little volumes are respectively No. 10 and 11 of a series of concrete workers' reference books. Both give helpful, practical suggestions for manipulating cement for the purposes indicated by the titles of the books. Any man who is reasonably skillful with his hands ought to be able to follow the suggestions given in these volumes.

LES RAVAGEURS. Rëcits sur les insectes nuisibles à l'agriculture. Par J.-H. Fabre, correspondant de l'Institut. Un vol. in-18, illustré de 16 planches horstexte en photogravure. Paris: Librairie Ch. Delagrave, 1912.

M. Fabre has made an international reputation for himself as a scientist who knows how to present the facts of entomology in a popular and readable way. The denizens of the garden, the meadow and the field are here described with a literary charm that commands admiration. The book is written in dialogue form, which has the advantage of injecting the human element into the discussion.

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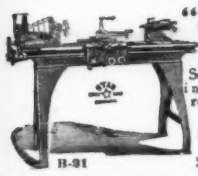

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Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12723) F. C. De M. asks: Can you advise process of staining or coloring sheet aluminium a dead black? A. A formula for blackening aluminium is as follows: White arsenic, 1 ounce; sulphate of iron, 1 ounce; hydrochloric acid, 12 ounces; water, 12 ounces. Dissolve the iron and aresenic in the acid and add the water. Clean the aluminium thoroughly with fine emery powder and wash before immersing it in the blackening solution. When the blackening is deep enough, dry off with fine sawdust and lacquer.

(12724) R. C. J asks: Some time ago the SCIENTIFIC AMERICAN contained an account of how a high-votage line had broken and how the current passed across a plowed field, fusing the soil into a hard mass. Why not use this idea in the construction of roads? How much current would you need to fuse the earth three inches deep? A. We are not able to answer your question as to making a road by the fusion of the earth by an electric current. The accidental fusion of a line across a field is a very different matter from the making of a roadbed wide and deep enough to serve for traffic. The cost, even where electricity is very cheap, would certainly be very heavy.

(12725) D. M. writes: According to the scientists, investigations show that the Aurora is no doubt due to streams of electric corpuscles which are thrown off from the sun during sunspot activities, and repelled by the repulsive force of light at immense velocities in all directions from that orb, and that when the earth encounters such streams they are drawn toward the magnetic poles, where they recompose or condense, as it were, producing the beautiful auroral light.

The strange feature of the case is that in all the active displays which I have observed, the motion of the light is always upward, for one will see a brilliant patch of light start at the bottom of the curtain or streamer and shoot upward with a tremendous speed, giving one the idea that such electricity was being discharged away from the earth and not being received, for under such conditions the light would appear, I should think, as falling toward the earth.

Again, if such electrical energy was being drawn toward the earth, why does not the Aurora touch the earth within the immediate vicinity of the magnetic poles? From recent observations the altitude of the Aurora varies from within a few miles to eighty or more, while in some of the earlier works on the subject, a curtain was observed to be only a few hundred feet above the ground, while rays have been seen to apparently touch the ground in Arctic regions, but perhaps this was the effect of mirage. Weather Bureau kites and captive balloons have, I understand, reached an altitude of ten miles. Now, do you not think they would be of some value in determining condition of temperature, pressure, humidity, and electrical state of the atmosphere if sent up during an aurora? For as before stated, such displays, especially in the zone of maximum frequency, which passes through Norway, etc., occur at no very great height. If such calculations are correct, a kite or balloon could be sent right into the heart of the Aurora's mysterious glow, and much might be gained. I should like very much to know more about this interesting phenomena, and what some of your readers might have to say. A. The occurrence of magnetic disturbances simultaneously with auroral displays, and the fact that auroral streamers coincide, as nearly as we can tell, with lines of magnetic force, are two good reasons, but not the only ones, for believing that the auroras themselves are of electrical origin. But it is not yet certain that this origin is the bombardment of the outer atmosphere by streams of solar electrons. Indeed, recent calculations by Prof. Schuster show that even if a stream of electrons should leave the sun, their mutual repulsion would completely dissipate them before they possibly could reach the earth. However, as Schuster says, there conceivably may be solar streams of non-electrified particles that somehow or other excite auroral activity, but this is mere speculation. The electrical nature of auroras is fully conceded, but what it is that excites them to activity is not definitely known. Auroral streamers *appear* to shoot upward, not because of the direction of the discharge, which, like lightning, is far too fast to follow, but because of growth and increased intensity. With decrease of intensity they often appear to drop back, but this too gives no indication of the direction of the electrical discharge. Just why there is an auroral ring around each terrestrial magnetic pole inside of which auroras are seldom seen, is not yet a settled question. It has been extensively discussed but not fully solved. As suggested, kites and balloons might be sent up at the time of an auroral discharge, but there is no good reason to expect the gain in this way of much additional knowledge about auroras. Kites seldom reach an elevation greater than four miles, nor captive balloons more than two miles, while the region of the auroral discharge appears (nearly always) to be thirty miles and more. Sounding balloons have, in rare instances, gone to an elevation of 18 miles. This is far short of the main auroral level.

Facing The Future Fearlessly

By FRANKLIN O. KING

"Ring out the Old; Ring in the New. Ring out the False; Ring in the True." It Rings in Your Ears, and Well it May. Tennyson never Wrote a More Beautiful Poem, and You never Read a More Helpful One. Read It Over Again. Every Man should Strike a Balance on New Year's Morning, even Though He May Have Been a little Off his Balance New Year's Eve. It's Easy to Turn Over a New Leaf, but it Takes a Real Man to Keep it Turned. "Eternal Vigilance" is the Price, not Only of Liberty, but of Habits, Health and Happiness—Now and Hereafter.

Good **Resolutions** will Become **Realizations** only when backed up By **Persistent Purpose.**

How about Your Balance Sheet for 1912? Haven't You Charged off a Lot of Things to **"Profit** and **Loss"** that Ought to Be On the Credit Side of the Ledger? Haven't You Frittered away a Great Deal of Your Hard Earned Cash for Petty Pleasures, or Lavish Luxuries, when You Could Have Laid By Something for the Inevitable **"Rainy Day"?** How Much Better Off are You than Last Year, or the Year before That? True, You have "Kept the Wolf from the Door," but by a Little Economy and Self Denial You Might have Begun the Erection of a Fortification that would Forever Free your Family From Fear of Its Ferocious Fangs.

Two Texas Gulf Coast Products

Your Good Job may not Always Last. Some of These Days a Younger Man May Fill Your Place. I said a "Younger," not a *Better* Man. The Gray is Creeping into Your Hair, and the **Boss** is Likely to Forget the Splendid Things You Did—Once Upon a Time. "Yo' Ben a Good Old Wagon, But Yo' Dun Broke Down." "The World Wants a **Winner,** and Won't Worry Along With Wornout Workers."

"Parted From the Pay-Roll" is a Little Drama in which You may Expect to Play the Principal Part Some Sad Saturday, P. M. Then the "Good Fellows" who Helped You Spend Your Money Will Likely Pass By on the Other Side, and the Only Place You can Look for **Sympathy** will be in the Dictionary.

Let Us, therefore, "Ring Out False Pride," and Hereby Firmly Resolve to Establish a New Record for 1913, which Will Enable You to **Face** the **Future Fearlessly.** Strikes, Lockouts, Panics and Periods of Financial Depression *Cannot Depress You,* if You Will Make It a Rule to Save a Little Something Every Day. Again I Repeat It—*Saving* is the Antidote for *Slaving.*

The Best Incentive to Persistent and Systematic Saving is the Desire to Get a Home. The Best Place I know of to Get a Home is in the Rain Belt of Gulf Coast Texas, where You can Grow Three Big Money-Making Crops a Year, and where Irrigation and Fertilization do Not Eat Up the Profits Your Hands Create.

I believe you could save Twenty-Five Cents a Day if You tried. I know you would Try if you Realized that our Growers of Figs, Strawberries and Early Vegetables clear a net Profit of $300 to $500 an Acre. Men have Realized more than $1,000 an Acre growing Oranges in our Country. Remember that our Early Vegetables get to Northern Markets in Mid-Winter and Early Spring, when they command Top Prices.

One German Truck Grower on adjoining lands this spring realized nearly $500 from three-fourths of an acre of Strawberries. You could do as well if you only Tried, and on a Ten-Acre Tract **Find Financial Freedom.**

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Sixty-Ninth Year

SCIENTIFIC AMERICAN *for* 1913

AS WE go to press for the first issue of the 69th year of the Scientific American we should like to be able to publish an approximate table of its contents for 1913. Although this may be possible for some journals, with the Scientific American it is obviously out of the question. As stated at the head of our editorial colums: "The purpose of this journal is to record accurately, simply and interestingly the world's progress in scientific knowledge and industrial achievements." Scientific knowledge and industrial achievements are undergoing phenomenal developments, the progress of which will be chronicled in these pages. But what these developments will be, who can foretell? So, in forecasting the Scientific American of 1913 we can only refer back to the year just past as an index of the manner in which the subjects for the coming year will be treated; and as a measure of our own development, we invite comparison between the Scientific American for 1912 and that for 1911.

Although a table of contents is now out of question, we are able to announce a series of subjects that will come in for special attention. These will appear in special magazine numbers which will be continued this year, as they have been in the past two years. The list of subjects is indicative of the broad scope of the paper, which concerns itself on the one hand with the vast powers of nature, and on the other with the minute micro-organisms of bacteriology, the great agricultural operations made possible with modern machinery.

In the following list of magazine numbers it should be understood that the subjects given out will not monopolize the whole of the number, but each number will contain the same variety of subjects as do the regular issues of the Scientific American.

Motor Number
JANUARY 11

NEXT week the Scientific American publishes its fifteenth annual motor number. This unlike the other magazine numbers will be wholly devoted to the subject of the automobile and the motor truck. Topics of special articles are Automobile Bodies, Past, Present and Future, Partnership Ownership of a Car, Kerosene Engine Carbureters and Converters. How to Realize Economy with a Motor Wagon, Left-side Steering and Central Control, and the Capabilities of the Motor Truck and the Horse Compared. There will also be a valuable table classifying all American-made cars according to price, showing what cars can be bought for $500, $1,000, $1,500, etc.

Agriculture
FEBRUARY 1

FOLLOWING our practice of the last two years the February number will take up the subject of agriculture, giving the latest information on improved agricultural machinery and the scientific-treatment of soils.

Water Supply
MARCH 1

THE tallest building in New York towers 750 feet above the ground—the deepest hole sinks as far below ground, giving access to the Acqueduct Tunnel under the East River. Although the acqueduct has been described from time to time in the Scientific American, it is hard to give an adequate idea of the greatness of this engineering undertaking. In our March issue a general survey of the whole aqueduct will be given.

Harnessing Nature
APRIL 5

COAL will not last forever. What shall we do when it is gone? Of the great powers of nature we have succeeded in harnessing so far only those of the wind and the flowing stream, but there are open to us still the enormous power of the waves and the energy that the sun is constantly sending us in the form of light and heat. Many efforts have been made to utilize wave power, but so far with little success. Just what has been done will be fully explained in the April issue. Also there will be an article on the utilization of sun power in which line some very promising experiments have been made.

Safety in Travel
MAY 3

IT is time for radical improvements in the conduct of railroads. It is time that the automatic stop for trains was adopted, not to relieve the engineer of responsibility, but to act as a check upon him and to come into operation only in case of a lapse on his part.

Bacteriology
JUNE 7

THIS issue is taken up with the greatness of the infinitely small. It will explain how some micro-organisms are our enemies and others our friends, and how we may make alliance with the latter to war upon the former.

Compressed Air
JULY 5

NOT a steel building, not a bridge, not a tunnel of any description has been built in this city without the use of compressed air. Why should this power be used in place of electricity? The advantages of compressed air and the peculiar conditions requiring its use will be explained in the July issue.

Electric Furnace
AUGUST 2

IN this issue we shall deal with the electric furnace as used, not in the manufacture of steel, but in the laboratory where the intense heat it furnishes permits of chemical operations that enable us to reproduce artificially nature's own work in manufacturing diamonds, precious stones and other valuable products.

Waterways
SEPTEMBER 6

IN this number we are reminded that we must not be so engrossed in the Panama Canal as to forget the important waterways in our own immediate neighborhood: The Cape Cod Canal, the Canadian canals, harbor improvements, the widening and deepening of our navigable streams, etc.

Paper—Its Use in the Arts
OCTOBER 4

THE subject which is to be taken up in this issue is full of great interest. Not many realize to what extent paper and wood pulp enter into the arts, to suggest the various uses here would be to spoil the coming story.

Great Inventions of Our Time
NOVEMBER 1

ALTHOUGH all important inventions are described in the Scientific American, there are some that stand out above the rest and that are of an epoch-making character. These will come in for particular attention in the November issue.

Panama-Pacific Exposition
DECEMBER 6

THE last magazine number of the year will be devoted to the Panama-Pacific Exposition, and the opening of the Panama Canal to active service, which will mark a new commercial era for the United States.

The subjects referred to in the magazine numbers will be written by specialists in their several departments. Although we have made special detailed reference to these numbers, it must not be inferred that all the interesting material will appear in them. The regular weekly numbers will contain the same variety of matter that they have in the past, and we shall by no means follow the policy of saving the best for the magazine numbers.